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Analysis of Physicochemical Changes During the Ripening of Cavendish Banana and Velchi Banana

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Abstract

Fruits and vegetables play very important role in our day-to-day life because of their nutrition parameters. In recent years organic cultivation is more popular as there is more demand for organic fruits and vegetables. Due to very high nutrition benefits and considering the easily availability of banana, it is most demandable and afforded by common man. Consumer decides the quality of banana based on their physical characteristics. Simple experiment was carried out to study and analyse physical properties, nutritional properties of two varieties of banana Cavendish Banana and Velchi banana. The study shows that the colour of banana changes gradually from dark green to yellow with brown spots which increases in ripeness. The banana weight goes on reducing with ripening days. The 21.83% and 9.8% reduction weight is observed in Cavendish and Velchi Banana respectively. The pulp to peel ratio increases with increase in ripening. Ratio varied from 1.69 to 1.77 for cavendish and 3.2 to 4.8 for Velchi. The pH value goes on increasing during the ripening days whereas once fruit is overripe it starts decreasing. The pH value varies from 4.2 to 5.4. Total Soluble Sugar gradually increases till banana becomes overripe. TSS varies from 4.5 to 26.7. The majority characteristics used for grading are colour, pulp to peel ratio, TSS and pH. This paper represents the analysis of Cavendish banana and Velchi banana based on colour, TSS and pH. The study shows TSS goes on increasing with ripening whereas pH decreases once banana overripe.

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Keywords
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Physicochemical Properties;
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Introduction

In the tropical areas of the world banana is the most cultivated and widely consumed fruit.[1] In tropical and subtropical countries of the World banana is widely distributed and consumed.[2,3] It can be consumed cooked as well as uncooked. It can be easily

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and economically accessible to common people.[4] Presently India is one of the largest countries in terms of banana production.[5] Among the various types of banana Cavendish and Velchi bananas are produced more in Maharashtra. With growing stage and maturity there is changes in the physical as well as chemical properties of banana.[6,7] The following table shows the top 5 states of India cultivating the banana in high numbers.

Table 1: Production (Tonnes) Year: 2021-22

Sr No.	State	Production	Share (%)
1	Andhra Pradesh	5,838.88	17.99
2	Maharashtra	4,628.04	14.26
3	Gujarat	3,907.21	12.04
4	Tamil Nadu	3,895.64	12
5	Karnataka	3,713.79	11.44
6	Uttar Pradesh	3,391.01	10.45
7	Bihar	1,968.21	6.06
8	West Bengal	1,147.79	3.54
9	Assam	1,108.00	3.41
10	Chhattisgarh	585.52	1.8

Source: National Horticulture Board (NHB), India, 2021-22 (1st Adv. Estimate)

The Following Table Show the International Production of Banana

Table 2: International Production of Banana

Production in (000) MT: 2020			
Sr No.	**Country**	**Production**	**Share (%)**
1	India	31,504.00	26.29
2	China P Rp	11,513.00	9.61
3	Indonesia	8,182.76	6.83
4	Brazil	6,637.31	5.54
5	Ecuador	6,023.39	5.03
6	Philippines	5,955.31	4.97
7	Guatemala	4,476.68	3.74
8	Angola	4,115.03	3.43
9	Tanzania Rep	3,419.44	2.85
10	Costa Rica	2,528.72	2.11
	Total	84,355.64	

Source: Food & Agricultural Organisation (FAO), India

Banana fruit undergoes various physical and chemical changes during the ripening stage. The study of physical and chemical changes helps in handling and distribution of banana fruit in postharvest, packaging and marketing stage. This study will help to design the system.[8]

This paper aims to perform analytical study of two types of Bananas, Cavendish and Velchi. The study gives away the variation in physical and chemical properties of two varieties in unripe and ripen stages.[9] The paper includes analysis of physical properties like fruit weight peel and pulp weight, pulp

to peel ratio and chemical properties like Brix value, Total Soluble Solids (TSS), pH value and firmness.[10]

Materials and Methods

Methods and materials used by researcher consists of selection of two types of bananas, recording their physical characteristics like weight, peel thickness, pulp weight, Peel to Pulp ratio, colour and chemical properties like total soluble solids, pH value, Firmness etc[11]

Selection of Fruit

A freshly cut bunch of bananas of type Cavendish and Velchi were collected from College of Agricultural, Pune. Each day three bananas from the bunch are used. The experiment is done three times to get the uniform data and reduce the variations.[12] Both types of bananas used for experiment were kept at room temperature between 220C to 270C for 10 days. In these days bananas were fully changed from totally unripe to fully ripe[13,14]

Physical Characteristics

Fruit weight is measured daily by using the Electronic Kitchen Scale, model SF-400 having high precision strain gauge system. Peel weights were measured by peeling the banana. To measure the pulp weights peeled bananas were smashed uniformly and weighted. The Pulp to peel ratio was calculated by dividing the pulp weight to peel weight.

Pulp to peel Ratio = Pulp Weight/ Peel Weight ...(1)

Chemical Characteristics

Total soluble solids were measured daily using Handheld refractometer (Erma Inc, Tokyo, Japan). Each banana sample was smashed uniformly to get smooth pulp. A scoop of pulp was placed on main prism and closed day light plate to record the reading. The blue line indicated the TSS value.

The pH value was measured by standard pH meter by making the pulp more slurry. The firmness was determined by simple Hole Gauge Cone Penetrometer. The fruit was kept on surface and cone was inserted into it. Daily three fruits were taken from the bunch to measure the firmness'.

Results

The Various Physical characteristics such as Fruit Weight, Peel Thickness colour and Pulp weight and Chemical characteristics such as TSS(Brix), pH and Firmness of Cavendish Banana and Velchi banana were measured three times per day by the methods mentioned above and mean values are considered. The mean is calculated by using Advanced Microsoft Excel 2003 The following tables shows the readings for Cavendish and Velchi banana respectively.

Table 3: Physical and Chemical characteristics of Cavendish Banana

Day	Fruit Weight (g)	Peel thickness(g)	Pulp weight (g)	Pulp to peel ratio	Colour	TSS (Brix)	pH	Firmness (N)
1	105	39	66	1.692	Green	4.5	4.2	44.78
2	105	39	66	1.692	Green	5	4.2	43.56
3	103	38	65	1.71	Green with slight yellow	6	4.5	41.34
4	101	38	63	1.657	Green with slight yellow	6.8	4.5	36.79
5	95	37	61	1.648	Green with more yellow	7	5	35.23
6	93	34	58	1.705	Yellow	8	5.1	34.23
7	91	32	57	1.781	Yellow	12	5.2	31.89
8	87	32	57	1.781	Yellow with brown spot	16.7	5.2	28.12
9	85	31	55	1.774	Yellow with browner spot	19.5	5.2	24.78
10	82	30	52	1.733	Brown with slight shade of yellow	23.7	5.4	22.1

Table 4: Physical and Chemical characteristics of Velchi Banana

Day	Fruit Weight (g)	Peel thick ness(g)	Pulp weight (g)	Pulp to peel ratio	Colour	TSS (Brix)	pH	Firm ness(N)
1	71	18	58	3.222	Green	5	4.5	40.89
2	69	17	56	3.294	Green with Yellow tip	5.7	4.5	37.34
3	68	16	55	3.437	Yellow with Green tip	7	4.6	35.34
4	67	15	52	3.466	Yellow	8	4.6	31.67
5	66	13	52	4	Yellow with few brown spot	13	4.8	30.56
6	65	12	50	4.166	Yellow with browner spot	20	4.9	26.45
7	64.5	11	49	4.454	Yellow with brown at tip	23	4.9	24.56
8	64	10	48	4.8	Brown with slight shade of yellow	26	5	22.87
9	63.5	9	47	4.9	More Brown with shade of yellow	26.5	5.1	21.47
10	63	9	46	4.8	Brown	27	5.3	19.78

Discussion

Physical Properties

Banana Weight

As ripeness increases the weight of banana for both varieties decrease. This could be due to increase in moisture content and reduction in firmness. The different parameters were responsible for this mass weight reduction such as peel thickness, moisture content, post harvesting storage, fruit handling.[15] The reduction in weight is observed as 21.83% for Cavendish Banana and 9.8% for Velchi Banana. The Standard Deviation for Cavendish and Velchi Banana is 8.51 and 2.61 respectively.

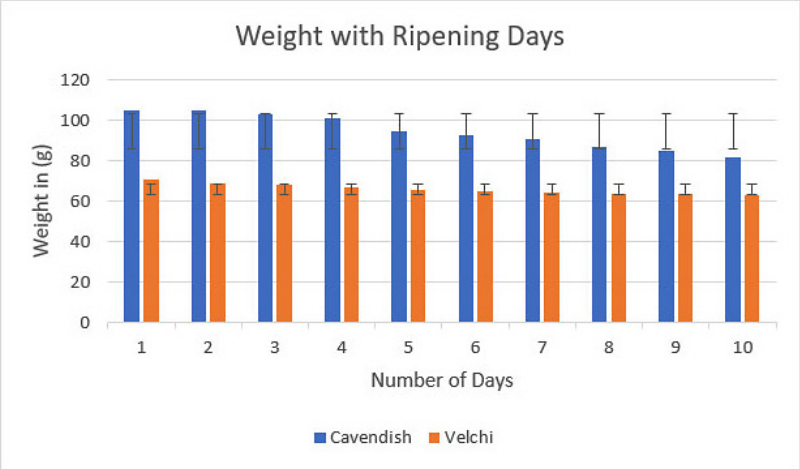

Fig. 1: Changes in Weight with ripening days for Cavendish and Velchi Banana

Pulp to Peel Ratio

Initially the peel of both Bananas were very thick. The thick skin not only protects the fruit but also plays an important role in the entire ripening stages. The thickness reducing due to the modification of cell wall.[16] The average value for peel weight was reported as 35g and 14g for Cavendish and Velchi. The values reported by Kachru, R. P., Kotwaliwale are 41.9 and 18.4 17. The result shows that peel of Cavendish Banana has thicker skin and Velchi Banana. The Pulp to peel ratio was varied from 1.69 to 1.77 for cavendish and 3.2 to 4.8 for Velchi.

This was due to decrease in peel thickness and increase in moisture content. The rapid increase of sugar causes the reduction in moisture. The pulp moisture content increasing due to osmotic transfer from peel to pulp and carbohydrate breakdown with the ripening stages.[18] The standard deviation obtained for Cavendish and Velchi Banana is 0.04 and 0.75 respectively. Hence the pulp to peel ratio increasing with increase in the value of TSS.[19]

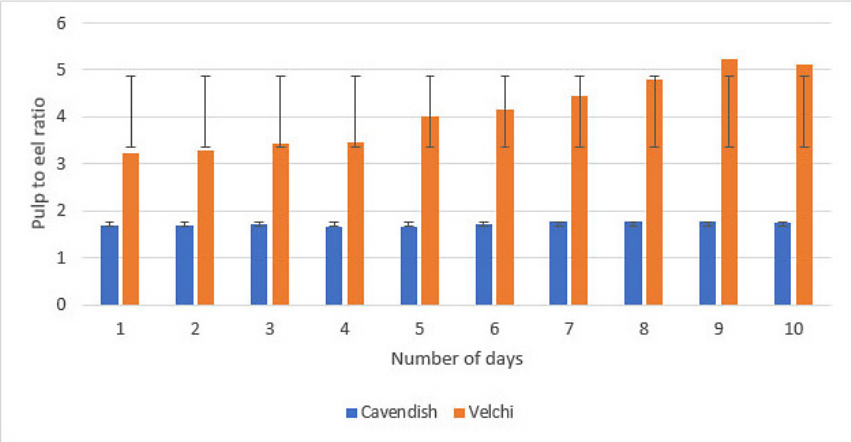

Fig. 2: Pulp to peel ratio with ripening days for Cavendish and Velchi Banana

Chemical Properties

4.2.1 Total Soluble Solids: The Total Soluble Solids (TSS) increasing with ripening days. The TSS values obtained are varied from 4.5% Brix to 23.7 % Brix and 5% Brix to 26 % Brix for Velchi. The magnitude of TSS depends on how the ripening is taking place organically or artificially. Many times, cultivators induce ethylene gas to speed up ripe in banana. Similar reading is reported in literature review.[20,21]

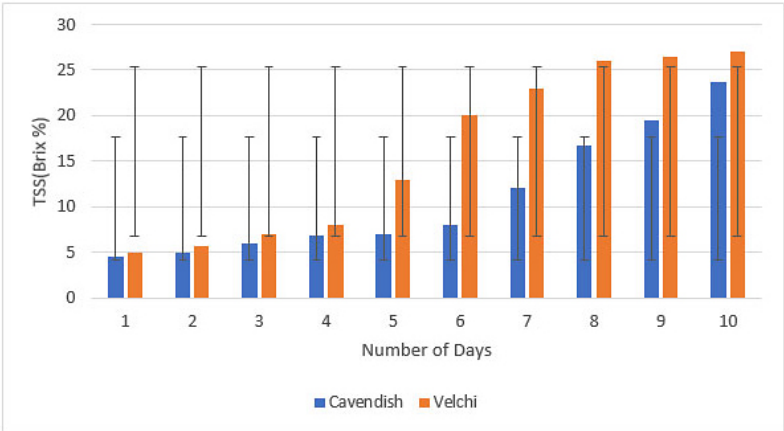

Fig. 3: TSS with Ripening Days for Cavendish and Velchi Banana

Firmness

The result shows that the firmness reducing with the ripening stages. This is due to the increase in the softness of pulp. The softness is majorly because of conversion of starch into sugar. The similar findings were also reported by Peleg in banana.[22,23] The standard deviation obtained for Cavendish and Velchi banana is 7.71 and 7.19 respectively

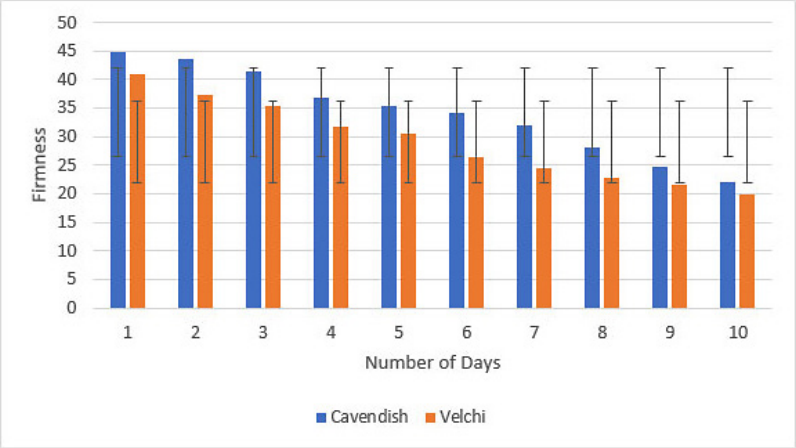

Fig 4: Firmness with Ripening Days for Cavendish and Velchi Banana

The pH value of banana increases gradually with ripening and decreases when over ripened. The pH value mainly depends upon the total amount of acids increasing during ripeness. Malic acid and citric acid are responsible for tartness and oxalic acid is responsible for taste of banana.[24,25,26]

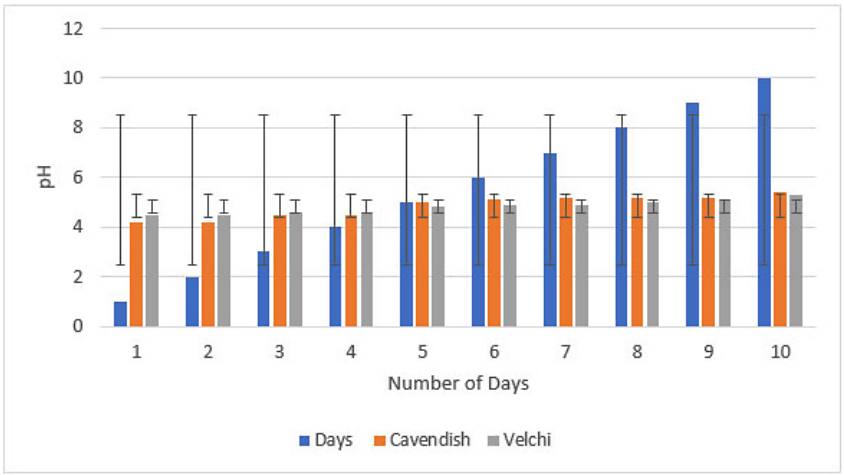

Fig. 5: pH with Ripening Days for Cavendish and Velchi Banana

Conclusion

The experimental and recorded data shows significant difference in physical and chemical properties in Cavendish and Velchi banana. With ripening days reduction in fruit mass weight is 21.83% and 9.3% for Cavendish and Velchi respectively. The peel weight reduces with ripening days. It was observed that peel of Cavendish was thicker compared to Velchi. It was observed that Cavendish banana when peel if turned brown the fruit is not advisable for consumption whereas for Velchi fruit it is a good condition to consume. The peel colour changes from green to brown with increasing in ripening days. The Cavendish banana takes more days to overripe compared to Velchi banana. The TSS value increasing with ripening days as a result the fruits are sweeter. Testing of chemical properties can cause the destruction in fruit sample so they can be tested in laboratory. This data can be useful to design a system at the time of transportation, processing, and marketing of banana.

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Conflict of Interest
Author declares that there is no conflict of interest regarding publication of this paper.

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