

Effect of Geospatial Variations on Fruits Structure and Sensory Properties of Mango Variety Alphonso

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ABSTRACT: Mango is a major fruit crop of tropical region and Alphonso is the most popular variety of mango. Different locations have varying qualities of Alphonso mangoes as growing conditions and locations determine the quality of mango. In this study, different geospatial parameters viz. altitude, temperature, rainfall, humidity, soil nutrients were analysed to know their effect on quality of mango var. Alphonso. Panicles were colour tagged at four different locations viz. Bengaluru (930 m mean sea level), Chikkaballapura (865 m MSL), Hogalgere (836 m MSL) and Ramanagara (747 m MSL) which are about 228km distant from each other. Mangoes were harvested at their optimum maturity and quality was analysed. The results revealed that the fruits from Hogalgere had the highest longitudinal (96mm) and equatorial (75.74mm) size and firmness (74.52HC). The sensory analysis revealed that the fruits from Hogalgere had excellent scores for appearance (4.90), colour (4.95), texture (4.62), aroma (4.89), taste (4.68) and overall acceptability (4.64) after nine days of storage. The results emphasise the effect of the geospatial conditions on the fruit structure and sensory parameters. Understanding geospatial conditions is useful in determining the quality and shelf life of the fruits.

Keywords: Altitude, Geospatial, Firmness, Size, Sensory parameters.

INTRODUCTION

Mango is major fruit crop of the tropics and sub tropics, particularly in Asia. It is considered as a king of the fruits because of the taste and nutritional benefits. It is originated in South East Asia. Being a climacteric fruit, it is generally harvested at mature firm colour break stage, which ripens during the marketing process. Among the varieties, Alphonso is one of the most popular and widely grown variety, which is rated best in the world due to its strong aroma, intense peel coloration, delicious taste, and high nutritive value. But Alphonso from different locations comes in different sizes and appearance. In fact, the sensory qualities differ from place to place. This might be because of the influence of different growing conditions. The geospatial parameters such as altitude, soil, variations in temperature and relative humidity during the season of fruit production greatly impact on the growth rate and fruit development through an influence on the rate of mineral nutrients uptake from the soil. Temperature has a positive effect on size of the fruit (Calderón-Zavala *et al.*, Prathiksha *et al.*,

al., 2002; Hatfield and Prueger, 2015). It also helps in development of sweetness in the fruits and further significantly affects the fruit quality and postharvest characteristics (Ambuko *et al.*, 2017). Altitude of a location has an impact on the temperature. Locations at higher altitudes have lower temperature and vice versa (Emongor, 2015). High temperature during mango fruit production has reported to cause lower fruit acidity and high sugar content due to increased dry matter accumulation (Hofman *et al.*, 1997) and low temperature favours higher ascorbic acid content of the fruit (Hollinger, 1996). These conditions in turn effect the sensory parameters of the fruits. Heavy rains can cause flower and fruit drop, resulting in reduced yield and also effecting the accumulation of sugars in the fruits. However, rainfall during the final maturity stage of the fruits hastens the maturation process and also the harvest. To understand the influence of different pre harvest factors, studies are limited and the work and information is scanty. Therefore, this study aims to study the effect of geospatial parameters on fruit size,

firmness and sensory parameters in mango var. Alphonso.

MATERIAL AND METHODS

Collection of samples: The experiment was conducted in four locations viz. Bengaluru, Chikkaballapura, Hogalgere and Ramanagara located at the altitudes of 930, 865, 836 and 747 m MSL respectively during 2018-2020. The panicles were colour tagged using at different locations as and when they emerged and they were harvested when they reached optimum mature stage, sorted and disinfected with 200 ppm sodium hypochlorite. Then, fruits were pre-cooled and de-sapping was carried out by trimming the stalk to 0.6-1.0 cm and kept in de-sapping tray for about 4 hours at room temperature. Fruits were ripened using portable ethylene gas can (Make: Chemtron, Model: Ripelene-6) in ripening chamber at room temperature (28°C). The size and colour of mangoes was recorded at 3 days interval.

Fruit size (equatorial and longitudinal): The fruit size was measured using Vernier callipers. For longitudinal size, the length was measured from the blossom end to the distal end. For equatorial size, it was measured at the broadest part of shoulders.

Fruit firmness: Non-destructive firmness of the fruit was measured using durometer (Make: HD Digital Shore Hardness Meter, Japan, Model: Digital Eco.). The mango was held stable in a hand and the durometer was pressed against it in perpendicular angle until the presser foot makes firm contact with the fruit. Direct readings were noted from the screen.

Sensory qualities: The organoleptic evaluation of mango fruits were conducted on the basis of appearance, colour, texture, aroma, taste and overall acceptability by a semi trained panel using a 5-point rating scale as laid out by Lawless and Heymann (1999). The score used for assessing the mango fruit is indicated as follows 5-Like; 4- Like slightly; 3- Neither like nor dislike; 2-Dislike slightly; 1-Dislike.

The data obtained were subjected to statistical analysis as per the guidelines suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The panicle emerged early in Ramanagara as compared to other locations. This might be due to the availability of favourable day and night temperatures of below 13°C during night in Ramanagara prior to any other location which triggered the florigen hormone which in turn triggered the flowering. Similar results were attained by Amin *et al.*, (2013) in mango cultivars Samar Bahisht Chaunsa and Sindhri. Also, Burondkar *et al.*, (2000) conveyed similar results. The mango var. Alphonso took around 90 to 110 days after flowering to attain right maturity for harvesting. Due to high temperature (38.5°C), the starch synthesis and other metabolic activities are relatively higher at lower elevations. Therefore, the fruits from Ramanagara (747 m MSL) matured earlier as compared to other locations. Dhanraj *et al.*, (1985) observed similar maturity pattern in apple.

Fruit size: Among different locations, the fruits from Hogalgere recorded the highest fruit size (longitudinal and equatorial). Also, they maintained the size throughout the storage period (Table 1).

Table 1: Fruit size (mm) and firmness (HC) in mango variety Alphonso from different locations.

	Day 0	Day 3	Day 6	Day 9	Day 12	Day 15
Longitudinal size						
Bengaluru	88.60	90.07	87.72	85.87	83.69	80.46
Chikkaballapura	90.65	94.82	92.30	89.73	87.16	84.02
Hogalgere	96.42	97.40	95.79	92.51	90.29	87.60
Ramanagara	88.65	90.22	85.91	80.69	75.91	70.57
S.Em.	1.32	1.33	1.38	1.38	0.38	1.37
C.D.	3.98	4.01	4.14	4.15	4.14	4.12
Equatorial size						
Bengaluru	68.00	67.53	64.98	63.57	61.03	57.41
Chikkaballapura	72.20	71.40	69.51	66.95	63.75	62.27
Hogalgere	75.74	74.14	71.78	69.02	66.60	63.77
Ramanagara	72.84	71.06	68.92	66.43	63.71	58.97
S.Em.	0.85	0.87	0.84	0.74	0.76	0.71
C.D.	2.33	2.61	2.52	2.23	2.27	2.14
Firmness						
Bengaluru	69.25	63.40	54.73	45.73	37.00	24.60
Chikkaballapura	65.41	61.20	54.87	44.47	35.60	25.67
Hogalgere	74.52	72.93	66.60	57.53	45.93	32.20
Ramanagara	72.26	70.00	60.87	49.87	38.80	27.60
S.Em.	0.78	0.81	0.81	0.94	0.84	0.78
C.D.	2.36	2.45	2.44	2.83	2.54	2.34

Significant at 5%

Fruits stored at ambient condition in PHT lab in Bengaluru

Fruits from Bengaluru (Stored during month of May, Avg. temp.: 28.97°C, RH: 54.55%)

Fruits from Chikkaballapura (Stored during month of May, Avg. temp.: 28.97°C, RH: 54.55%)

Fruits from Hogalgere (Stored during month of June, Avg. temp.: 27.73°C, RH: 61.15%)

Fruits from Ramanagara (Stored during month of April, Avg. temp.: 28.31°C, RH: 53.19%)

The equatorial size ranged from highest in Hogalgere (75.74mm) to lowest (68mm) in Bengaluru. Similarly, the longitudinal size ranged from highest in Hogalgere (96.42 mm) to lowest in Bengaluru (88.60mm).

The main reason contributing for the size of the fruits is the available nutrients in the soil. The fruit size positively correlated with available nutrients in the soil like nitrogen, phosphorous, calcium, copper, zinc and manganese as stated by Kumar *et al.* (2013). Sarker *et al.* (2012) reported that higher concentrations of nutrients in the soil improves the physical parameters of mango fruit. Also, the fruits from Hogalgere received maximum duration of light as they took a maximum number of days (106-109) for maturity after flowering. The temperature has a positive impact and in Hogalgere it favoured the development of good-sized mangoes (Calderón-Zavala *et al.*, 2002; Hatfield and Prueger, 2015). Therefore, the development was better in fruits from Hogalgere. These results were in agreement with the results of Karanjalkar *et al.* (2018).

Firmness: The firmness in the pulp ranged from maximum in Hogalgere (74.52HC) to minimum in Chikkaballapura (65.41HC). Similar trend was maintained in the fruits until the end of storage period. The firmness mainly depended on the sugars and carbohydrates like pectin polymers in the pulp (Taiz and Zeiger, 2017). The pulp of the fruit gradually lost its firmness due to cell wall degradation and also due to enhanced activity of enzymes polygalacturonase and conversion of cell wall calcium content from

protopectin to pectin and pectic acid. The firmness in stored mangoes gradually decreases as the number of storage days progress as reported by Jha *et al.*, (2006).

Sensory properties: Quality is a measure of the degree of excellence or degree of acceptability by the consumer. Sensory characteristics of quality include appearance, colour, texture, aroma, taste and overall acceptability. The colour increases the attractiveness of fruits and in most cases; it is used as a maturity index. Appearance, colour, texture, sugars and acids and their interaction are considered as a most important parameter affecting consumer's acceptance (Daquino *et al.*, 2016). Among the locations, Hogalgere fruits received the highest scores for all the sensory attributes *viz.* appearance (4.90), colour (4.95), texture (4.62), aroma (4.89), taste (4.68) and overall acceptance (4.64) after nine days of storage since they had attractive peel colour, optimum brix-acid ratio *etc.* Loss of texture is one of the main factors limiting the quality and postharvest shelf life of mango var. Alphonso fruits.

Correlation: The fruit size, firmness and shelf life were correlated with the days taken from flowering to harvest and the geospatial parameters like altitude, temperature, rainfall and relative humidity of the different locations (Table 2). There was significant and positive correlation between the shelf life and the days after flowering (0.98), equatorial size (0.80) and fruit size (0.71), whereas, negative correlation was observed with relative humidity (-0.86) and maximum temperature (-0.68).

Table 2: Correlation of geospatial conditions with physical parameters of mango var. Alphonso.

Variables	DAF	Altitude (m MSL)	Rainfall	RH	Temp (Max)	Temp (Min)	Eqa. Fruit size	Long. Fruit size	Fruit firmness	Shelf life
DAF	1									
Altitude (m MSL)	0.34	1								
Rainfall	-0.12	0.64*	1							
RH	-0.73**	-0.89**	-0.41	1						
Temp (Max)	-0.54	-0.92**	-0.30	0.93**	1					
Temp (Min)	0.20	0.15	-0.62*	-0.20	-0.48	1				
Eqa. Fruit size	0.57	.048	-0.86**	0.07	0.13	0.44	1			
Long. Fruit size	0.92**	0.37	-0.33	-0.71**	-0.67*	0.58	0.64*	1		
Fruit firmness	0.60*	-0.47	-0.34	0.05	0.35	-0.30	0.71**	0.36	1	
Shelf life	0.98**	0.53	0.08	-0.86**	-0.68*	0.16	0.80**	0.40	0.71*	1

DAF: Days after flowering; MSL: Mean sea level; RH: Relative humidity; Eqa.: Equatorial; Long.: Longitudinal; *: significant correlation at 5 per cent level ($P_{0.05}$); **: highly significant correlation at 5 per cent level ($P_{0.05}$)

The longitudinal fruit size and fruit firmness showed significant positive correlation with the days after flowering (0.92 and 0.60 respectively), whereas, longitudinal fruit size was negatively correlated to relative humidity and maximum temperature (-0.71 and -0.67 respectively). Also, the different soil nutrients were correlated with the fruit size, firmness and sensory parameters (Table 3) and it was reported that, different nutrients had positive effect on the quality parameters. There was significant and positive correlation between

the shelf life and the available soil nutrients *viz.* nitrogen (0.78), phosphorus (0.62) and potassium (0.74) and also with equatorial fruit size (0.80) and firmness (0.71) of the fruit. The available nitrogen showed significantly positive correlation with equatorial (0.86) and longitudinal (0.94) fruit size and firmness of the fruit (0.60). Exchangeable calcium also showed significantly positive correlation with equatorial size (0.73) and fruit firmness (0.94).

Table 3: Correlation of available soil nutrients with physical parameters of mango var. Alphonso.

Variables	Available Nitrogen	Available Phosphorus	Available Potassium	Exchangeable Calcium	Exchangeable Magnesium	Equ. Fruit size	Long. Fruit size	Fruit firmness	Shelf life
Available Nitrogen	1								
Available Phosphorus	0.62*	1							
Available Potassium	0.34	0.80**	1						
Exchangeable Calcium	0.45	0.83**	0.35	1					
Exchangeable Magnesium	0.21	0.66*	0.16	0.96**	1				
Equ. Fruit size	0.86**	0.60*	0.07	0.73**	0.60*	1			
Long. Fruit size	0.94**	0.45	0.37	0.13	-0.13	0.64*	1		
Fruit firmness	0.60*	0.97**	0.63*	0.94**	0.82**	0.71**	0.36	1	
Shelf life	0.78**	0.62*	0.74**	0.14	-0.15	0.80**	0.40	0.71*	1

Eq.: Equatorial; Long.: Longitudinal; *: significant correlation at 5 per cent level ($P_{0.05}$); **: highly significant correlation at 5 per cent level ($P_{0.05}$)

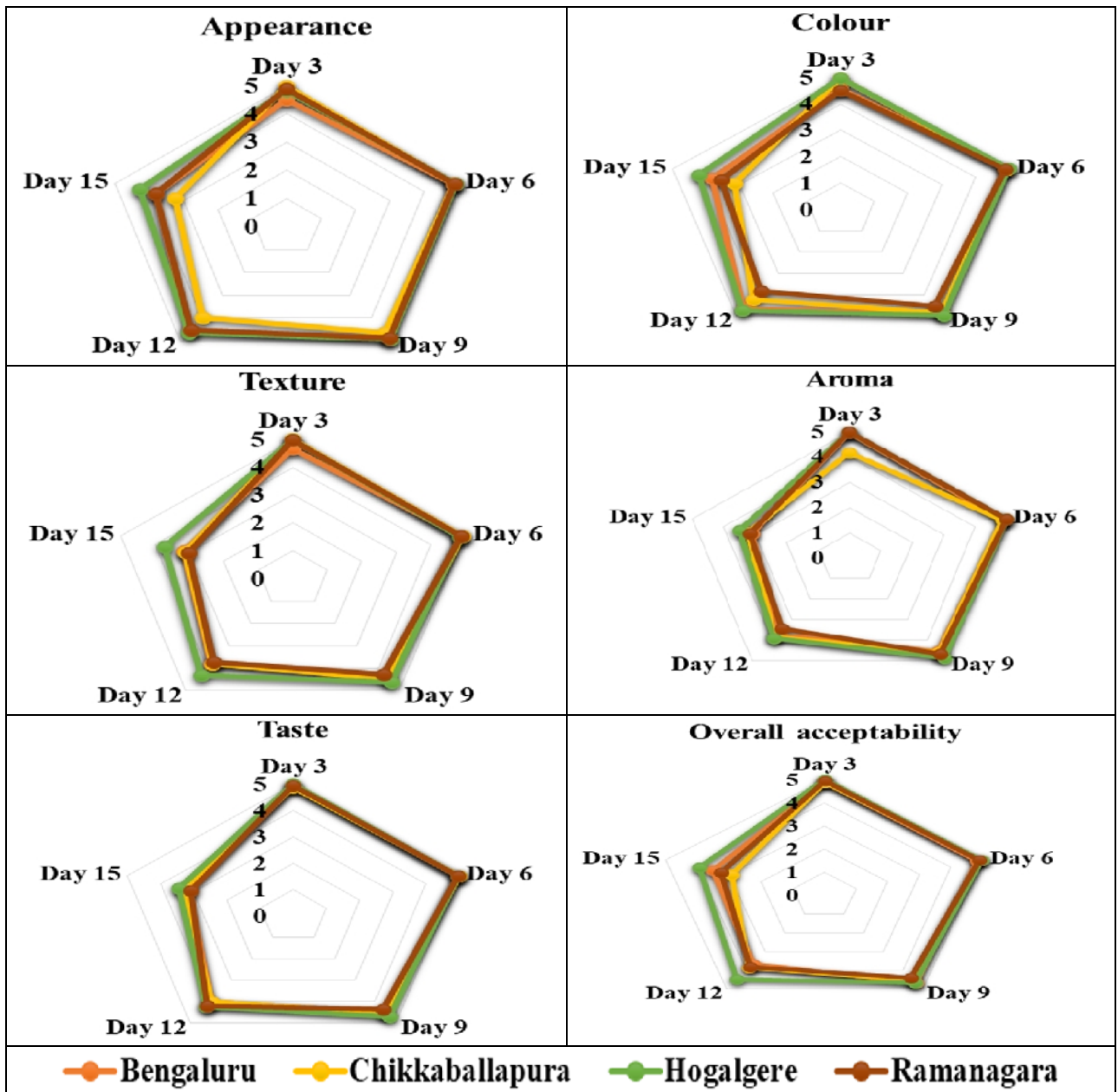


Fig. 1. Effect of geospatial variations on sensory parameters of mango var. Alphonso during storage.

CONCLUSION

The size, firmness and sensory parameters of mangoes are influenced by the temperature, rainfall, soil nutrients and the duration for which they remain on the trees. The geospatial variations cause considerable difference in the final quality of the mangoes. Also, these factors have impact on the days required from flowering to maturity. There was clear indication of difference in number of days required for flowering and the shelf life of the fruits from different locations. Postharvest management of fresh mangoes is a tedious job, and requires careful monitoring. However, understanding geospatial condition and its intricate correlation details may aid in maintaining the postharvest quality and extending the shelf life of mangoes. Therefore, the geospatial variations can be studied in depth to understand the reason behind the difference in the qualities of mangoes from different locations

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Conflict of interest. Nil.

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