

Development of Grading System in Red Banana for Value Addition

P. R. Geetha Lekshmi, Philipose Joshua,
C. S. Jayachandran Nair

Received 8 September 2018; Accepted 14 October 2018; Published on 5 November 2018

Abstract Banana is an important tropical fruit which plays unique role in food and nutritional security of developing countries. Banana has rich diversity and among the different cultivated bananas, Red Banana is known for its characteristic flavor and taste which belongs to *Musa* AAA group. Red Banana production as well as demand is expanding at a faster rate and by the adoption of modern agricultural practices, huge bunches are produced with big fruits. Even though the big Red Banana fruits are eye appealing, consumers preference for purchase may be different.

Post-harvest handings of banana is a complicated and reasonably long process as compared to many other fesh produce. Banana is sent to domestic markets as bunches, and for exports and super markets banana hands are separated and packed. All major super markets have pre-determined specifications based on consumer preferences and the fruits are pre-packed and priced according to the specifications. So a differential pricing system for hands with in a bunch could be deliberately introduced in marketing of Red Banana for the benefit of producers and consumers. Hence an attempt was made to assess the consumer preferences and quality standards of Red Banana so that farmers can produce banana according to the demand of consumers and get better return for their input and ultimately can reduce the post-tharvest losses due to its high perishability. The study revealed that the highest consumer preference was for Red Banana hands with a weight more than or equal to 3 kg and less than kg, number of fingers more than or equal to 15 to less than 20, finger weight more than or equal to 150 g to less than 200 g, finger length more than or equal to 16 cm to less than 20 cm and finger girth more than or equal to 13 cm to less than 16 cm, when hands were purchased as a unit. Thus different grades viz. Grade A, Grade B, Grade C and Grade D were developed based on preference on weight of hands, number of fruits, fruit (finger) weight and fruit (finger) length. Popularization of system for grading would encourage farmers for the production of quality produce which in turn will fetch better returns through

P. R. Geetha Lekshmi*
Assistant Professor,
Department of Post-Harvest Technology, College of Agriculture,
Vellayani, Thiruvananthapuram, Kerala Agricultural University,
India
e-mail : geethapr1975@gmail.com

Philipose Joshua
Former Professor & Head,
Department of Post-Harvest Technology,
College of Agriculture, Vellayani, India

C. S. Jayachandran Nair
Former Professor & Head,
Department of Pomology and Floriculture,
College of Agriculture, Vellayani, India
*Corresponding author

an orderly marketing system that is vital for consumer driven agriculture.

Keywords Red banana, Consumer preference, Grading, Marketing.

Introduction

Banana is one of the largely consumed tropical fruits in the world and the oldest cultivated fruits of India with socio-economic significance. Even though India is among the top banana producing countries, it is contradictory in export mainly due to perishable nature of banana and lack of knowledge on fruit quality standard to match the international standards (Patil and Rawale 2012). Banana is rich in biodiversity and well known for its high nutritional value, being rich in starch and sugars, vitamins A, C and minerals such as potassium, phosphorus, calcium and magnesium. Among the different bananas, Red Banana is known for its characteristic flavor and taste which belongs to *Musa* AAA group. It is popularly known as Chevazhai or Chenkadali. The plant is robust and tall with a characteristic deep red colored pseudostem. The purplish red peel color and the special aroma of the fruits attract the consumers and fetches higher price in the market. Red Banana is geographically distributed in southern parts of Kerala and Tamil Nadu.

Red Banana production as well as demand is increasing at a faster rate and by the adoption of modern agricultural practices, huge bunches are produced with big fruits. Banana is sent to domestic markets as bunches, and for exports and super markets banana hands are separated and packed. Even though the big Red Banana fruits are eye appealing, consumers preference for purchase may be different. Major constraint associated with post-harvest handling of Red Banana is its high perishability leading to post-harvest losses. Banana has a golden opportunity as fresh and processed form in both domestic and export market. But India's low figure in terms of banana export is due to poor post-harvest management practices, lack of market awareness, quality and supply chain management. Fruit quality in terms of size, color, shape, freshness, shelf life and safety has become of utmost importance in trade and consumers demand

higher specifications where suppliers and traders face challenges. The food marketing sector is giving thrust to meet consumer demand for wide array of attributes for fresh fruits and vegetables (Moser et al. 2011).

Beginning with brand labelling of individual banana fruit clusters, increasing emphasis was placed on fruit quality and these quality standards vary with markets. The highest standards were for competitive markets and usually lower standards for protected markets which accept smaller fruit with a lower average grade. Standard specifications are lowered when there is a shortage of fruit or market demand is high and raised when there is surplus and the market is saturated. Quality standards of banana, which vary from country to country, help to assure the delivery of fruits of specified size or quality to the particular market. Size of the fruit refers to the finger length and thickness. The main quality standards of banana for the French are reported as minimum finger length of 15 to 17 cm and thickness (caliper grade) 30 to 35 mm and with respect to finger length, consumer surveys showed that most buyers of banana preferred medium sized fingers of 15 to 20 cm (Stover and Simmonds 1987). Banana is graded generally based on length and diameter of fruits as Grade A (length 19 cm, diameter 35 mm) grade B (length 17 cm, diameter 32 mm) and Grade C (length 15 cm, diameter 29 cm) and size below this are rejected (Bandyopadhyay 2013).

The importance of super markets in fruit trade is increasing not only in export but also in local and retail markets. All major super markets have pre-determined specifications based on consumer preferences and the fruits are pre-packed and priced according to the specifications. So a differential pricing system for hands with in a bunch could be deliberately introduced in marketing of Red Banana for the benefit of producers as well as consumers where significant variation in size of Red Banana bunches is observed. Grading studies in banana is meagre and no work was found for developing grades for Red Banana. Hence an attempt was made to assess the consumer preferences and quality standards of Red Banana so that farmers can produce banana according to the demand of consumers and get better returns for their input and ultimately can reduce the post-harvest losses.

Table 1. Grade standards selected for Red Banana hands.

	Weight of hands	No. of finger hand
1.	≥4 kg	≥20
2.	≥3 to <4 kg	≥15 to <20
3.	≥2 to <3 kg	≥10 to <15
4.	>2 kg	<15

Materials and Methods

Grading of Red Banana was done based on the physical parameters viz., weight of hands, number of fingers per hand, weight, length and girth of fingers and consumer preference. Scoring was done according to the consumers criteria for selection of banana at the time of purchase given by Dadzie and Orchard (1997). Red Banana bunches (50 bunches) of different sizes were procured from instructional Farm, College of Agriculture, Vellayani and progressive farmers. The hands from bunches were separated and samples were grouped as in Tables 1 and 2.

A total of 60 respondents with assured income and have purchasing power were selected for this study to ascertain consumers criteria for selection of Red Banana at the time of purchase. They were asked to score the groups (as per Table 1 and 2) according to their preferences at the time of Red Banana purchase based on the criteria given. The score to be given of preference were most preferred-5, preferred-4, satisfactory-3, somewhat preferred-2, least preferred-1. All the scores obtained were analyzed and grouped according to the mean score of preferences in order to obtain the consumer preference.

Results and Discussion

The percentage consumer preference for weight of Red Banana hands, number of fingers in one hand, finger length, finger weight and finger girth based on mean scores are described in Table 3.

When Red Banana hands were considered, the highest consumer preference was for hands of weight more than or equal to 3 kg to hands less than 4 kg (61.91%) with a mean score of 4.38 followed by hands of more than or equal to 2 kg to hands less than 3 kg (28.57%) with a mean score of 3.91%. The least scor-

Table 2. Grade standards selected for Red Banana fingers.

	Weight of fingers	Girth of fingers	Length of fingers
1.	≥200 g	≥ 16 cm	≥20 cm
2.	≥150 to <200 g	≥13 to <16 cm	≥16 to <20 cm
3.	≥100 to 150 g	≥10 to <11 cm	≥12 to <16 cm
4.	<100 g	<10 cm	<12 cm

ing (1.91%) was for hands weighing less than 2 kg.

Hands with more than or equal to 15 fingers to less than 20 fingers obtained a score of 4.43 was preferred by most of the respondents. This was followed by hands of more than or equal to 10 fingers to less than 15 fingers with a mean score of 3.91. Hands with number of fingers less than 10 were least preferred and got a mean score of only 1.81.

For Red Banana finger weight, the highest preference (57.14%) was for fingers weighting more than or equal to 150 g to less than 200 g that recorded the highest score of 4.43. It was followed by fingers weighing more than or equal to 100 g to less than 150 g with a score of 3.20 and the least preference was for fingers with weight less than 100 g scoring 1.81.

Red Banana fingers with length more than or equal to 16 cm to less than 20 cm got the highest preference (61.91%) with a mean score of 4.24 followed by fingers with more than or equal to 12 cm to less than 16 cm recorded a mean score of 3.95. Fingers with less than 12 cm length were least preferred.

Fingers with a girth of more than or equal to 13 cm to less than 16 cm were most preferred (57.14%) and scored 4.43 followed by fingers of girth more than or equal to 10 cm to less than 13 cm with a mean score of 4.0. The preference for fingers with girth more than 16 cm and less than 10 cm were same and were least preferred with a score of only 2.05.

Considering the above mentioned average physical characters, grades are suggested and their specifications are given in Table 4.

Grade A included hands with weight more than four kg, number of fingers more than 20, finger weight more than 200g, finger length more than 20 cm and

Table 3. Percentage of consumer preference and average score for selected characters of Red Banana hands. *Score given to consumer preferences at a maximum of 5.

Weight of hands (kg)	Least preferred *(1)	Some what preferred *(2)	Satisfactory *(3)	Preferred *(4)	Most preferred *(5)	Mean scores
≥4	14.29	28.57	28.57	19.05	9.52	2.81
≥3 to <4	–	4.76	14.29	19.05	61.91	4.38
≥2 to <3	–	–	38.10	33.33	28.57	3.91
<2	28.57	57.14	9.52	4.76	–	1.91
No. of fingers per hand						
≥20	19.05	23.81	23.81	13.33	–	2.71
≥15 to <20	–	4.76	9.52	23.81	61.91	4.43
≥10 to <15	–	–	33.33	42.86	23.81	3.91
<10	38.10	42.86	19.05	–	–	1.81
Weight of fingers (g)						
≥200	38.1	28.57	19.05	14.29	–	2.10
≥150 to <200	–	–	19.05	23.81	57.14	4.43
≥100 to <150	–	19.05	52.38	28.57	–	3.20
<100	47.62	28.57	19.05	4.76	–	1.81
Length of fingers (cm)						
≥20	19.05	19.05	47.62	14.29	–	2.57
≥16 to <20	–	–	9.52	28.57	61.91	4.24
≥12 to <16	–	–	28.57	47.62	23.81	3.95
<12	47.62	28.57	23.81	–	–	1.76
Girth of fingers (cm)						
≥16	38.10	28.57	23.81	9.52	–	2.05
≥13 to <16	–	–	14.29	28.57	57.14	4.43
≥10 to <13	–	–	23.81	52.38	23.81	4.00
<10	38.10	28.57	23.81	9.52	–	2.05

finger girth more than 16 cm.

Grade B comprised of hands weighing more than or equal to 3 kg to less than 4 kg, number of fingers more than or equal to 15 to less than 20, finger weight more than or equal to 150 g to less than 200 g, and finger length more than or equal to 16 cm to less than 20 cm and finger girth more than or equal to 13 cm to less than 16 cm.

Grade C included hands with weight more than or equal to 2 kg to less than 3 kg, number of fingers more than or equal to 10 to less than 15, finger weight more than or equal to 100 g to less than 150 g, finger length more than or equal to 12 cm to less than 16 cm and girth more than or equal to 10 cm to less than 13 cm.

Grade D consisted of smaller fruits with hands weighing less than 2 kg, number of fruits less than 10, finger weight less than 100g, finger length less than 12 cm and finger girth less than 10 cm. Similar grading was reported in Nendran (Gouthami 2001, Raju et al. 2002).

Finding of the study showed that the highest consumer preference was for Red Banana hands with a weight more than or equal to 3 kg and less than 4 kg, number of fingers in a hand more than or equal to 15 to less than 20, finger weight more than or equal to 150 g to less than 200 g, finger length more than or equal to 16 cm to less than 20 cm and finger girth more than or equal to 13 cm to less than 16 cm, when hands were purchased as a unit. The consumers

Table 4. Suggested grade specifications for Red Banana hands.

Grades suggested	Specifications				
	Weight of hand (kg)	No.of fingers hand	Weight of finger (g)	Length of finger (cm)	Girth of finger (cm)
Grade A	≥4	≥20	≥200	≥20	≥16
Grade B	≥3 to <4	≥15 to <20	≥150 to <200	≥16 to <20	≥13 to <16
Grade C	≥2 to <3	≥10 to <15	≥100 to <150	≥12 to <16	≥10 to <13
Grade D	<2	<10	<100	<12	<10

are giving more importance on quality of the product rather than quantity and are ready to pay more. Similar observations were recorded and reported that the consumer demand for higher quality and ready to pay for the quality product forced the modern value chain to shift their focus to market oriented production practices (Bandyopadhyay 2013).

Red Banana hands of big size, with weight more than 4 kg and finger weight more than 200 g were preferred to a certain extent mainly by elite groups and the undersized banana hands, with weight less than 2 kg and finger weight less than 100 g were preferred the least. So it is observed that medium sized hands got the highest consumer preference. The Red Banana bunches of required size can be produced by regulating the production practices viz., adjusting spacing, fertilization, bunch cultural practices and thus can meet standards for high quality fruits. In a study conducted to analyse the major problems faced by Red Banana contract farming growers of Karnataka, about 88.57% of the farmers opined about the lack of grading techniques and standards to measure the quality of the produce as their major constraint (Naduvanamani 2007).

In Maharashtra, the leading producer of banana in India, generally fruits are graded visually at the unloading site mostly on the basis of weight of bunch and graded as A, B, and C. A grade bunch weighing 15 to 20 kg is sent to distant market and B grade weighing 10 to 15 kg for marketing with in Maharashtra and C grade and rejected bunches are sold in local markets (Wasker and Roy 1993). They further suggested the separation of banana hands from bunches in producing area itself to reduce unnecessary expenditure on transport of waste resulting from bunches and improve the post-harvest handling. In banana Grand Naine, mature fruit with pale green

color disappeared angularity which is a measure of maturity at 34-35 mm finger diameter and 21-22 cm finger length (Prabha and Kumar 2015).

Nowadays artificial neural network system has been evolved for detecting banana disease (Tigadi and Sharma 2016) and intelligent grading systems for banana fruit using neural network arbitration (Olaniyi et al. 2017). Thus, the banana grading in international market is reaching to high quality specifications while our marketing system is reluctant to adopt the grading system which should be changed for reaping better advantage from consumer driven agriculture.

Conclusion

consumer preference for quality standard of fresh produce is in vertical trend. As bananas are generally retailed as hand as a unit and cost is fixed on weight basis, the consumer is paying the same price to fruits irrespective of their size and appeal. Grading system of banana hands based on physical parameters such as weight of hands, number of fingers in a hand, finger weight, finger length and finger diameters would help the consumer to get a properly defined product for his money as they are willing to pay more for quality produce. The farmers could get better returns for their quality produce and ultimately encourage them to produce bunches of consumer preference. Red Banana hands of 3 to 4 kg, 15 to 20 fingers and finger weight 150 to 200 g, finger length 16 to 20 cm, finger diameter 13 to 16 cm recorded the highest consumer preference. Hence the grading system proposed in this study could be used commercially for standardizing the production as well as marketing of Red Banana.

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