**Sensory evaluation of triploid (AAB& ABB) banana genotypes**

**ABSTRACT**

Sensory quality is a composite of product characteristics that impart value to the buyer and consumer. Consumers prefer fruits that look good, firm and offer good flavour and nutritive value. Producers and handlers are first concerned with appearance and textural quality along with long post harvest life. Present study was undertaken at ICAR-AICRP on Fruits, KRC. College of Horticulture, Arabhavi to study the Sensory evaluation of triploid (AAB & ABB) banana genotypes during 2018-20. Twenty one triploid banana genotypes belonging to AAB group and seventeen ABB groups were used for the evaluation. Significantly higher values were observed in Popoulu (9.00) which was on par with Nendran (8.99), Rasthali (8.98) and Nendrapadathi (8.89) while minimum score was noticed in Dhudhasagar (6.31) with respect to colour and appearance among AAB group while, in ABB group, significantly maximum value were noticed in Budubale (9.00) which was on par with Udhayam (8.97) while minimum score was recorded in BCB-II (6.10). With regard to overall acceptability, the analyzed results revealed that, among AAB group, significantly maximum values were noticed in Nendran (9.00) which was on par with Popoulu (8.99), Rajapuri (8.94), Sakkarebale (8.80), Manjeri Nendran (8.57), Rasthali (8.86), Nendrapadathi (8.63) and H-1 (8.44) while, minimum value was noticed in Poovan (4.49). Among ABB group, significantly higher values were noticed in Budubale (9.02) which was on par with NRCB-10 (7.92), Udhayam (7.69), Pisang Awak (7.42) and Karibale (7.16) while minimum score was noticed in NRCB-7 (4.96) for overall acceptability.

*Keywords*:Banana, sensory, triploid,color, tasteand overall acceptability

**INTRODUCTION**

 “Banana (*Musa sapientum*), is a quite valuable and exportable product among the important fruit crops of the tropical and sub-tropical regions of the world. It is considered 4th staple food after rice, corn and wheat and grown in more than 150 countries, producing 110 million tons of banana fruit per annum” (Sitthiya et al*.,* 2018; Falcomer et al*.,* 2019). “Banana fruit is highly nutritious having much health benefits and is good source of readily available energy; thus considered the best food for sportsmen and others undergoing high physical activities. Its worldwide high consumption is due to its caloric contribution, vitamins and minerals especially potassium and its sensory characteristics” (Maertens et al*.,* 2012). “Its demand in the world reaches to nearly 70% of total world fruit consumption” (Du et al*.,* 2017; Khushboo, 2017). “Sensory profiles of the banana fruit have a great role on consumer’s choice for a specific variety and ultimately affect the sale in the local as well as the international markets” (Mahmood and Munir, 2018). Therefore, along with higher banana fruit yield, the consumer acceptance is also an important factor for any variety popularization in a region. Taking into consideration the yield and quality of the banana fruit, the current study was accomplished with the objective to evaluate the introduced banana varieties for yield and nutritional values at various ripening stages along with sensorial evaluation at fully ripened stage.

Banana fruits have been one of the favorite fruits in India. For preserving a firm pulp texture, good color and flavor and also to avoid from contusion, bananas are cut at a mature-green stage and exported to consumer countries. To predict quality factors of banana fruits, Finney *et al.,* (1967) [5] measured changing in firmness of banana fruits during the ripening treatment by means of a sonic technique. Ripening is a process, which increases the quality of the fruit, and it is part of the same process, which is accelerating the product towards post-market senescence (Ferris, 1991). This study aimed at assessing the sensory traits and sensorial acceptance, as well as the intention to purchase banana fruits from improved genotypes and commercial cultivars.

**MATERIAL AND METHODS**

 The present study on “Sensory evaluation of triploid (AAB & ABB) banana genotypes” was conducted at ICAR-All India Coordinated Research Project (ICAR-AICRP) on Fruits, Kittur Rani Channamma College of Horticulture, Arabhavi (University of Horticultural Sciences, Bagalkot) Karnataka during 2018-19 and 2019-20. Sufficient number of bunches were tagged at the fruit set stage of twenty one triploid banana genotypes belonging to AAB group and seventeen group belongs to ABB like, Bargibale (AAB), BangladeshMalbhog (AAB), CO-1 (AAB), Dudhsagar (AAB), H-1 (AAB), H-531 (AAB), Krishnavazhai (AAB), Malaikali (AAB), ManjeriNendran (AAB), Marrtman (AAB), Nendran (AAB), Nendrapadath (AAB), Palayankondan (AAB), Popoulu (AAB), Poovan (AAB), Rajapuri (AAB), Rasthali (AAB), Sakkarebale (AAB), Thiruvananthapuram (AAB), Vannan (AAB), Virupakshi (AAB),BCB-I (ABB), BCB-II(ABB), Budubale(ABB), Budumitga(ABB), Karibale(ABB), Karpurbale(ABB), Karpurvalli(ABB), Kothia(ABB), KovvurBontha(ABB), Monthan(ABB), NRCB-7 (ABB), NRCB-8 (ABB), NRCB-10(ABB), PisangAwak(ABB), Saba(ABB), Shanbale(ABB) and Udhayam(ABB)were used for evaluation. The tagged bunches were harvested with a curved knife when fingers were fully developed and when the fingers started to change their colour from dark green to light green and brought to the laboratory. Good and healthier bunches were selected, in that bunch, middle hand from the top and bottom rows was taken and kept in the laboratory for natural ripening and ripened fingers were used for the sensory study. One genotype was considered as a treatment and each treatment and was replicated thrice.

Sensory evaluation of fresh banana fruits was carried out by a semi-trained panel of 15 judges consisting of teachers and post graduate students of Kittur Rani Channamma Horticulture, Arabhavi. The fruit characters like colour and appearance, texture, taste, flavor, and overall acceptability of banana fruits were evaluated on a nine point hedonic scale using score card mentioned below (Ranganna, 2009).

**Chart 1: Sensory evaluation of fresh banana fruits**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hedonic scale** | **Colourand appearance** | **Texture** | **Tasteand flavour** | **Overall acceptability** |
| Like extremely | 9 | 9 | 9 | 9 |
| Like very much | 8 | 8 | 8 | 8 |
| Like moderately | 7 | 7 | 7 | 7 |
| Like slightly | 6 | 6 | 6 | 6 |
| Neither like or dislike | 5 | 5 | 5 | 5 |
| Dislike slightly | 4 | 4 | 4 | 4 |
| Dislike moderately | 3 | 3 | 3 | 3 |
| Dislike every much | 2 | 2 | 2 | 2 |
| Dislike extremely | 1 | 1 | 1 | 1 |

**STATISTICAL ANALYSIS**

The data recorded on the sensory evaluation were subjected to statistical analysis in completely randomized block design. Analysis done using Web Agri. Stat. Package 2 developed by ICAR research complex, Goa. Examination of the data was determined in accordance with Panse and Sukhatme (1985).

**RESULT AND DISCUSSION**

“Sensory evaluation of products is a chief means for determining the consumer acceptability. Consumers prefer fruits that look good, firm and offer good flavour and nutritive value. Producers and handlers are first concerned with appearance and textural quality along with long post harvest life” (Kader, 2012).

**Colour and appearance**

“Color is a very important attribute related to the attractiveness of the fruit that influences the initial acceptability of a product by consumers. The color differences observed among the banana cultivars could be due to their differences in sugar contents in the fruit” (Adubofuor et al., 2016; Aquino et al., 2017). “In the present study, Significantly higher values (Table 1) were observed in Popoulu (9.00) which was on par with Nendran (8.99), Rasthali (8.98) and Nendrapadathi (8.89) while minimum score was noticed in Dhudhasagar (6.31) with respect to colour and appearance amongAABgroup while, in ABBgroup (Table 2), significantly maximum value were noticed in Budubale (9.00) which was on par with Udhayam (8.97) while minimum score was recorded in BCB-II (6.10). Various studies have revealed the influence of fertilizers on the colour of fruits. Increased use of nitrogen fertilizers led to quality of fruits in terms of colour and keeping quality” (Murthy et al., 2011). Belayneh et al. (2014) and Hardisson et al*.* (2001) had mentioned about the change in peel color at different ripening stages and its impact on consumer acceptability.

**Flavor**

Banana flavour is mainly caused by esters, although appreciable quantities of free alcohols have also been reported (Perez et al.**,**1993 and Shiota, 1993).in the present investigation , it is evident that, Nendran (9.00) and Sakkarebale (9.00) has recorded significantly maximum values for flavour which was on par with Popoulu (8.99), Manjeri Nendran (8.98), Rajapuri(8.97), Nendrapadathi(8.64) and Malaikali (8.21) while minimum values were noticed in Poovan (2.31) among AABgroup (Table 1). In ABB group, significantly higher values werenoticed in Budubale(9.00) which wasfollowed byNRCB-10 (7.51) and Udhayam (7.18) while minimum values were recorded in NRCB-7 (4.10) for flavour (Table 2).This might be due to presence of more total soluble solids more reducing sugar and less acidity usually *acuminata* groups are superior in taste. These results are in line with Nowakuda and Tushemereirwe (2004). “The flavour of fruits improves during ripening and the different volatile compounds which contributes flavour in banana are Isomyl acetate, 2-pentanol acetate, 2- methyl-1-propanol, 3- methyl-1-butanol banana” (Jordan *et al*., 2001). “Flavour is the combined impression perceived *via* the chemical stimuli from a product in to the mouth. The consumer acceptance of fruits most often relies up on the inherent flavour and textural quality of the product” (Kader 2008).

**Taste**

Among AAB group (Table 1), Nendran (9.00) and ManjeriNendran (9.00) has recorded significantly maximum values for taste which was on par with Rasthali(8.99), Sakkarebale (8.98), Popoulu(8.96), ManjeriNendran(9.15),H-1(8.62), Rajapuri(8.56) and Nendrapadathi (8.23) while minimum values were noticed in Poovan (2.36). InABB group (Table 2), Budubale (8.98) has recorded maximum values for taste which was on par with NRCB-10 (8.00) and Udhayam (7.65) while, minimum values were recorded in NRCB-7 (3.65) for taste.This result is in opposition to the finding of Belayneh et al. (2013) who reported that Cardoba was not preferable in terms of taste and overall acceptability. Organic acid and sugars ratio primarily contribute towards sense of taste recognized by taste buds. Sweet or sour taste is dominant components in the taste of many fruits due to sugars and organic acids (AOAC, 2000).Muhammadet al. (2020)reported that, the cultivar ‘NIGAB-2’ was apparently considered the best for taste as compared to others. Sreedevi (2013) reported that organically cultivated banana varieties had significantly higher value for taste as compared to conventionally cultivated banana varieties. Taste is a balance between sugar and acid contents in banana. Malic, citric, tartaric and citric acids are the major acids in banana. The decrease in acidity reduction improves taste (Dadzie and Orchard, 1996).

**Texture**

Among AAB group (Table 1), significantly higher values for texture was noticed in Popoulu (9.00), Rajapuri(9.00),Nendran (8.99), ManjeriNendran (8.98), H-1 (8.96), Rasthali(8.69) and Nendrapadathi(8.65) while minimum value was noticed in Palayankodan (3.12). Significantly higher values were recorded in Budubale (8.96) which was on par with BCB-I (8.00), Karibale (7.99), Karpurbale (7.65) and NRCB-10 (7.56) while minimum values were noticed in Kovvur Bontha (3.67) for texture in ABB group (Table 2).Texture means the sensory manifestation of the structure or inner make up of a food product. Fruit texture is influenced by environmental, cultural, physiological and genetic factors (Sams, 1999) . Decrease in flesh texture has been reported due to excessive fertilization in many fruit crops (Blampied et al., 1998). High fertilization levels impaired the early solubilization of polyuronides resulting in the accumulation of low molecular weight water soluble polyuronides, which ultimately causes inferior texture of fruits (Jia et al*.*, 2006)

### Overall acceptability

 However in AAB group (Table 1), significantly maximum valueswerenoticed in Nendran (9.00)which wason parwith Popoulu (8.99), Rajapuri (8.94), Sakkarebale (8.80), Manjeri Nendran (8.57), Rasthali (8.86), Nendrapadathi (8.63) and H-1 (8.44) while, minimum value was noticed in Poovan (4.49). Among ABB group (Table 2), significantly higher values were noticed in Budubale (9.02) which was on par with NRCB-10 (7.92), Udhayam (7.69), Pisang Awak (7.42) and Karibale (7.16) while minimum score was noticed in NRCB-7 (4.96) for overall acceptability.It can be concluded that the panelists preferred the external appearance rather than internal quality of the banana varieties. This effect has previously been found by Karamura and Karamura (1995) .This results in conformity with the Muhammad *et al*. (2020) who reported that, NIGAB-2 variety was found the most acceptable by the panelist followed by NIGAB-1 and Pisang while, the local cultivar (Basrai) got lowest scores among the evaluated varieties, for the overall acceptability. Basrai was agreed to be relatively inferior, however was not rejected by the judges for overall satisfactoriness.A study on a comparative quality analysis of banana (var. Palayankodan) by Sreedevi and Suma (2015) found that, sensory parameters were found to be better in organically cultivated varieties. The increase in moisture content during ripening will improve the taste and aroma of the fruits (Appiah et al., 2011). During ripening, carbohydrates are hydrolyzed into sugars (Kays, 1991).

### Colour of ripened finger

###  The ripened finger colour code was recorded according to RHS colour chart as follows (Table 3). In the present study all the genotypes belongs to AAB and ABB are having light yellow to brilliant yellow after ripening stage.

**CONCLUSION**

 From the consumer’s point of view, the overall acceptability of fruit is very important because it determines the marketability of the fruit. The Overall acceptability for consumer preferences, genotype like, Nendran, Popoulu, Rajapuri, Sakkarebale, Manjeri Nendran and Rasthali among AAB group. In ABB group, overall acceptability was good in Budubale, NRCB-10, Udhayam, Pisang Awak and Karibale were relished by the panelmembers.

### Table 1: Sensory evaluation of triploid (AAB) genotypes of banana

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl.****No.** | **Genotypes****(AAB)** | **Colourand appearance** | **Flavour** | **Taste** | **Texture** | **Overall acceptability** |
| **AAB** |
| **1** | Bargibale | 8.34 | 4.98 | 6.85 | 5.63 | 6.45 |
| **2** | BangladeshMalbhog | 8.64 | 6.47 | 6.11 | 4.89 | 6.53 |
| **3** | CO-1 | 8.31 | 4.98 | 6.20 | 7.98 | 6.87 |
| **4** | Dudhsagar | 6.31 | 4.31 | 4.21 | 6.31 | 5.29 |
| **5** | H-1 | 8.68 | 7.21 | 8.62 | 8.96 | 8.44 |
| **6** | H-531 | 8.64 | 7.84 | 7.98 | 7.86 | 8.08 |
| **7** | Krishnavazhai | 6.98 | 7.81 | 4.31 | 6.34 | 6.36 |
| **8** | Malaikali | 7.98 | 8.21 | 7.21 | 6.99 | 7.60 |
| **9** | ManjeriNendran | 7.41 | 8.98 | 9.00 | 8.98 | 8.57 |
| **10** | Marrtman | 7.65 | 6.35 | 6.98 | 4.96 | 6.49 |
| **11** | Nendran | 8.99 | 9.00 | 9.00 | 8.99 | 9.00 |
| **12** | Nendrapadathi | 8.89 | 8.64 | 8.23 | 8.65 | 8.63 |
| **13** | Palayankondan | 8.32 | 4.98 | 4.12 | 3.12 | 5.14 |
| **14** | Popoulu | 9.00 | 8.99 | 8.96 | 9.00 | 8.99 |
| **15** | Poovan | 8.54 | 2.31 | 2.36 | 4.75 | 4.49 |
| **16** | Rajapuri | 8.59 | 8.97 | 8.56 | 9.00 | 8.94 |
| **17** | Rasthali | 8.98 | 8.52 | 8.99 | 8.69 | 8.86 |
| **18** | Sakkarebale | 8.21 | 9.00 | 8.98 | 9.00 | 8.80 |
| **19** | Thiruvananthapuram | 6.32 | 4.31 | 6.39 | 7.00 | 6.01 |
| **20** | Vannan | 6.00 | 4.78 | 4.32 | 6.98 | 5.52 |
| **21** | Virupakshi | 7.81 | 3.65 | 3.68 | 6.72 | 5.47 |
|  | **Mean** | **8.13** | **6.66** | **6.70** | **7.21** | **7.18** |
| **S.Em±** | **0.69** | **0.63** | **0.63** | **0.57** | **1.04** |
| **C.D.1%** | **2.59** | **2.44** | **2.42** | **2.18** | **2.98** |
| **C.V.** | **7.63** | **9.73** | **9.82** | **7.21** | **8.66** |

### Table 2: Sensory evaluation of triploid (ABB) genotypes of banana

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl.****No.** | **Genotypes (ABB)** | **Colourand appearance** | **Flavour** | **Taste** | **Texture** | **Overall acceptability** |
| **ABB** |
| **1** | BCB-I | 8.31 | 6.37 | 7.85 | 8.00 | 7.63 |
| **2** | BCB-II | 6.10 | 4.91 | 4.98 | 4.32 | 5.08 |
| **3** | Budubale | 9.00 | 9.00 | 8.98 | 8.96 | 9.00 |
| **4** | Budumitga | 7.12 | 4.98 | 6.20 | 6.31 | 6.15 |
| **5** | Karibale | 7.24 | 6.25 | 7.14 | 7.99 | 7.16 |
| **6** | Karpurbale | 7.00 | 6.00 | 4.51 | 7.65 | 6.29 |
| **7** | Karpurvalli | 6.31 | 6.10 | 5.32 | 6.87 | 6.15 |
| **8** | Kothia | 8.64 | 4.21 | 4.12 | 4.15 | 5.28 |
| **9** | KovvurBontha | 8.13 | 4.31 | 4.35 | 3.67 | 5.12 |
| **10** | Monthan | 8.62 | 4.65 | 4.36 | 4.65 | 5.57 |
| **11** | NRCB-7 | 7.85 | 4.10 | 3.65 | 4.23 | 4.96 |
| **12** | NRCB-8 | 7.00 | 4.61 | 4.75 | 5.62 | 5.50 |
| **13** | NRCB-10 | 8.61 | 7.51 | 8.00 | 7.56 | 7.92 |
| **14** | PisangAwak | 8.14 | 6.54 | 7.84 | 7.15 | 7.42 |
| **15** | Saba | 7.45 | 4.23 | 4.32 | 5.31 | 5.33 |
| **16** | Shanbale | 7.00 | 4.12 | 4.63 | 4.68 | 5.11 |
| **17** | Udhayam | 8.97 | 7.18 | 7.65 | 6.97 | 7.69 |
|  | **Mean** | **7.76** | **5.80** | **6.07** | **6.29** | **6.48** |
| **S.Em±** | **0.66** | **0.65** | **0.69** | **0.91** | **0.94** |
| **C.D.1%** | **1.23** | **2.53** | **2.66** | **2.51** | **2.15** |
| **C.V.** | **4.83** | **9.63** | **9.78** | **5.16** | **5.00** |

**Fig 1: Sensory evaluation of triploid (ABB) genotypes of banana**

**Fig 2: Sensory evaluation of triploid (ABB) genotypes of banana**

**Table 3: Colour of banana ripened finger and colour code recorded according to RHS colour sheet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl.****No.** | **Genomic****group** | **Genotypes** | **Colour** | **Colour code** |
| **1** | **AAB** | Bargibale | Lightyellow | RHS201511B |
| **2** | BangladeshMalbhog | Brilliantyellow | RHS20158A |
| **3** | CO-1 |  |  |
| **4** | Dudhsagar | Lightyellow | RHS201511B |
| **5** | H-1 | Lightyellow | RHS201511B |
| **6** | H-531 | Brilliantyellow | RHS20158A |
| **7** | Krishnavazhai | Brilliantyellow | RHS20158A |
| **8** | Malaikali | Lightyellow | RHS201511B |
| **9** | ManjeriNendran | Brilliantyellow | RHS20158A |
| **10** | Martaman | Lightyellow | RHS201511B |
| **11** | Nendran | Lightyellow | RHS201511B |
| **12** | Nendrapadathi | Lightyellow | RHS201511B |
| **13** | Palayankodan | Brilliantyellow | RHS20158A |
| **14** | Popoulu | Brilliantyellow | RHS20158A |
| **15** | Poovan | Brilliantyellow | RHS20158A |
| **16** | Rajapuri | Lightyellow | RHS201511B |
| **17** | Rasthali | Brilliantyellow | RHS20158A |
| **18** | Thiruvananthapuram | Lightyellow | RHS201511B |
| **19** | Vannan | Lightyellow | RHS201511B |
| **20** | Virupakshi | Lightyellow | RHS201511B |
| **21** | **ABB** | BCB-I | Lightyellow | RHS201511B |
| **22** | BCB-II | Lightyellow | RHS201511B |
| **23** | Budubale | Lightyellow | RHS201511B |
| **24** | Budumitga | Lightyellow | RHS201511B |
| **25** | Karibale | Lightyellow | RHS201511B |
| **26** | Karpurbale | Lightyellow | RHS201511B |
| **27** | Karpurvalli | Lightyellow | RHS201511B |
| **28** | Kothia | Lightyellow | RHS201511B |
| **29** | KovvurBontha | Lightyellow | RHS201511B |
| **30** | Monthan | Lightyellow | RHS201511B |
| **31** | NRCB-7 | Lightyellow | RHS201511B |
| **32** | NRCB-8 | Lightyellow | RHS201511B |
| **33** | NRCB-10 | Lightgreenishyellow | RHS20158B |
| **34** | PisangAwak | Brilliantyellow | RHS20158A |
| **35** | Saba | Lightgreenishyellow | RHS20158B |
| **36** | Sakkarebale | Lightyellow | RHS201511B |
| **37** | Shanbale | Lightyellow | RHS201511B |
| **38** | Udhayam | Lightgreenishyellow | RHS20158B |

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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