Trends in Biosciences 13(9), Print : ISSN 0974-8431, 567-572, 2020

Comparative Study of Physico-Chemical Characteristics of Banana Fruit

B. M. RATHOD[1*] M.S. RATHOD[2], P.P. THAKUR[3] and U.D. WAGHMARE[4]

[1,3,4]Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra
Department of Food Engineering and Technology ,
[2]Sant Longowal Institute of Engineering and Technology, Longowal, Punjab
**email: balasahebmit@gmail.com*

ABSTRACT

The present study was carried out to standardize the process for preparation of banana chips and selection of good cultivars for production of Banana chips.Three cultivars viz. Ardhapuri, Grand naine and Mahalakshmi were selected for screening for preparation of banana chips and snacks. Further, these samples were evaluated for their physico-chemical, textural characteristics and sensory qualities.

Keywords *physical chemical properties, waste index, moisture content, fiber content.*

India has made a fairly good progress in production of fruits and vegetables with a total production of 548.00 million tones in the year 2012-13, against 87.10 million tones during 1991-92. Banana is the main fruit in international trade and the most popular one in the world. In terms of volume of export, banana stands first and ranks second after citrus fruit in terms of value (Bramwell and Badrie, 1973).

Banana (*Musa Paradisiaca*) belongs to the family Musaceae. It is one of the oldest fruits known to mankind. Banana plants are the largest plants on earth without a woody stem. Banana is the most delicious fruit used as subsidiary food. It is consumed as table purpose as well as culinary fruit, its leaves are universally used for serving meals in South India and chopped banana stems are used as cattle feed. Some species of banana yield fibre, which is used for making ropes. The tip of inflorescence is cooked as a vegetable in some places. The plant is also used for decoration purpose in wedding, festivals and fairs. It is used as raw material in industries for preparation of banana powder, chips, juices and beer. The juice of banana stem is used in making paper bond, tissue paper etc (Amiruzzaman 1990). The pulp peel ratio increases during the development of fruit, from 1:1 to 4:1 depending on variety and maturity at harvest. During the storage ripening starch dullness dicreases from 20-23 to 1 per cent and the same time the soluble sugar increases from less than 1 to 20 per cent when the mature fruit ripens. The pulp peel ratio increases, partly as a result of water movement from the peel to the pulp associated with an increase of osmatic pressure in the pulp caused by the hydrolysis of starch (Gautam *et al.* ,2003).

It is estimated that in India alone 3 mt. of banana is wasted. A large quantity of marketable surplus fruit is available in all banana growing region which need to be processed and be converted into value added products (Pethe *et al.,* 2003).

Banana is a globally important fruit crop with 97.5 million tones of production. According to the Food and Agriculture Organization (FAO) estimations, world total exports of banana accounted for 15.9 million tonnes in 2004. Banana is also a very important staple food for many developing countries for their food security about 500 t. (Silva et al., 2009). India ranks first in area and production of banana in the world. It supports livelihood of million people, with total annual production of 11655.9 thousand tones from 435.0 thousand ha. with national average of 26.70 tonnes per ha. during 2003-04 (Annonymous, 2006).

Fried products are popular as snack foods. These are prepared from a variety of raw materials and vary in size, shape and composition, but all are prepared by deep fat frying in vegetable oils and have relatively large proportions of fat/oil. They have a very low moisture content and can therefore be stored under ambient conditions. Off-flavour and rancidity resulting from fat peroxidation is the major cause of spoilage in these products. Because of their high volatility, incorporation of antioxidants in oils has not proved very effective, but sprinkling of antioxygenic salts after frying and use of antioxidant-treated packaging materials have given encouraging results (Sharma *et al.***,** 1992).

MATERIALS AND METHODS

Physical characteristics of banana fruit

Physical features of fresh fruits are important as characterized by their specific color, shape and

weight of fruit etc. Physical properties aids in the further processing. Color is important attribute in judging the quality. The shape of fruits aids in the processing. All these characteristics were studied and average values are reported in Table-1.

The data on physical characteristics of banana fruit (Table 1) shows that the colour of fruits of Ardhapuri cultivar was Green , fruits of Grand naine cultivar was Light green and that of Mahalakshmi cultivar was yellowish green. The average weight of fruit of Ardhapuri cultivar was 180 g while weight of Grand naine was 162 g.and that of Mahalakshmi cultivar was 123 g.

MATERIALS AND METHODS

Materials

Collection of banana varieties

Banana varities was procured from local market and farmers fields. Raw materials for preparation of banana chips was procured from a local market.

Ingredient

Refined sunflower oil, red chilli powder, salt, packaging material and spices mix were purchased from Parbhani local market.

Chemicals

Chemicals of analytical grade were obtained from department of Food Chemistry and Nutrition, College of Food Technology,V.N. M.K.V. Parbhani.

Instruments

All the instruments were used from laboratories of niche area and Dept. of FCN, College of Food Technology, V.N.M.K.V., Parbhani

Physical characteristics and chemical composition of matured fresh banana

The raw fresh bananas were evaluated for proximate chemical composition. The physical characteristics of matured fresh banana also determined.

Average Weight of banana

Ten banana were selected average weight of banana is calculated, expressed in percentage.

Colour

Colour of banana verities is determined by visually.

Degree of angularity

Degree of angularity of selected banana varities was calculated by using anglometer (Amin A.N et al 2015)

Fullness index

Fullness index of selected banana varieties were calculated by using following formula

$$Fulness\ index = \frac{avarage\ length\ of\ banana}{weight\ of\ banana}$$

Waste index:

Waste index Calculated by following formula

$$waste\ index = \frac{weight\ of\ fruit - weight\ of\ pulp}{weight\ of\ fruit} \times 100$$

Per cent yield of pulp

The per cent yield of pulp is calculated on the basis of Weights of pulp after peeling (Amin A.N et al 2015)

$$\%\ Pulp = \frac{weight\ of\ pulp}{weight\ of\ fruit} \times 100$$

Pulp to peel ratio

Pulp to peel ratio of banana was calculated by following formula (Amin A.N et al 2015)

$$Pulp\ to\ peel\ ratio = \frac{weight\ of\ pulp}{weight\ of\ peel}$$

Chemical characteristics of Banana Fruit

The unripe banana and banana chips were analyzed for moisture, protein; fat, total ash, crude fibre, carbohydrates (Ranganna, 1976).

Moisture estimation

1. Weigh accurately about 5.0 g of the material in a dish.
2. Shake the dish until the contents are evenly distributed.
3. Place the dish in a hot air oven maintained at a 105°C (±2°C) to a constant weight.

Table 1: Physical characteristics of banana Fruits : cultivars –Ardhapuri, Grand naine and Mahalakshmi

Sr. No.	Physical Properties	Ardhapuri	Grand naine	Mahalakshmi
1.	Colour of banana	Green	Light green	Yellowish green
2	Weight of banana (g)	180	162	123
3	Weight of bunch(kg)	25.2	24.35	25.01
4	Fullness index	6.82	6.41	6.23
5	Degree of angularity	130.33	107.52	109.65
6	Weight of pulp (g)	107	96.5	84.5
7	Weight of peel (g)	73	65.5	38.5
8	Pulp to peel ratio	1.64	1.56	2.4
9	Edible index	59.44	59.5	68.37
10	Waste index	40.56	40.5	31.63

Calculation:

$$Moisture\ (\%\ by\ weight)=\frac{W-W1}{w}\times 100$$

Where,

W = weight in g of the material taken for the test.

W_1 = weight in g of the material after drying.

Carbohydrate :

Procedure and Calculation:

The total carbohydrates are calculated by difference method, after determining the percentage of moisture, ash, fat and protein.

Total carbohydrates = 100 – (A + B + C + D + E)

Where,

A = moisture % in the given sample.

B = ash content in the given sample.

C = fat content in the given sample.

D = protein content in the given sample.

E = crude fibre content (if present in the given sample)

Fat estimation:

1. Weigh the sample in extraction thimble placing a Whatman filter paper before use and closing it by cotton plug, and extract with petroleum ether in a Soxhlet extractor.

Table 2: Chemical characteristics of banana Fruit.

Sr. No.	Parameters	Ardhapuri	Grand naine	Mahalakshmi
1	Moisture (%)	75.4	76.33	75.76
2	Carbohydrate (%)	22.84	23.66	23.21
3	Fat (%)	0.33	0.39	0.38
4	Protein (%)	1.09	1.07	1.11
5	Ash (%)	0.9	0.8	0.8
6	Dietary fibre(%)	2.6	2.5	2.6
7	Ascorbic acid (mg/100g)	11.0	8.7	8.9

2. And then keep it for extraction for about 24hrs.(extraction period may vary from 4hrs at a condensation rate of 5 to 6 drops/sec to 16hrs at 2 to 3 drops/sec)
3. Dry the extract on a steam bath for 30 min. cool in desiccators and weigh.
4. Continue at 30min.Interval, this alternate drying and weighing until the difference between two successive weighing is less than 1mg. Note the lowest mass.

Calculation

$$Fat(\%\ by\ mass) = \frac{M1-M2}{M} \times 100$$

Where,

M_1 = weight in g of the material taken for the test.

M_2 = weight in g of the material after drying.

M = weight in g of the sample taken for test.

Protein estimation

1. Accurately weigh 0.7g to 2.2g of sample into the digestion flask.
2. Add to this 0.7g of Mercuric oxide and 15g of Anhydrous sodium sulphate and 25ml of sulphuric acid.
3. Place the flask in an inclined position on a heater and heat gently until foaming ceases. Boil vigorously until the solution becomes clear and then continue boiling it for 1 to 2 hrs.
4. Cool, add about 200ml of distilled water, 25ml of Sodium sulphate solution and add without agitation 60ml of 40% NaOH solution.
5. Immediately connect the flask to the water condenser dip into the measured quantity of Std. H_2SO_4 acid in the collecting beaker.
6. Rotate the flask to mix the contents of thoroughly, and then heat immediately until all the ammonia has distilled over (150ml minimum).
7. Lower the collecting beaker before stopping distillation and wash the tip of the condenser with distilled water.
8. Back titrate excess acid with Standard Sodium hydroxide solution using methyl red indicator. The end point is from orange red to yellow. Correct for blank determination in reagents.
9. Blank is conducted by following the same procedure using 2gm of sugar in place of sample.

Calculation

$$Nitrogen\ Content(\%\ by\ mass) = \frac{(B-S)\times N\times 14\times 100}{W\times 1000}$$

Where,

B = volume in ml of the std. NaOH required for blank titration.

S = volume in ml of the std. NaOH required for sample titration.

N= exact normality of the NaOH used for titration,

W = weight in gm of the sample taken for test.

Total ash

1. Weigh 3g of sample in a dried crucible which is previously air oven dried and weighed. Heat the crucible gently on a flame.
2. Then strongly in a muffle furnace at 550°C (± 20°C) till grey ash results.
3. Cool the crucible in desiccators and weigh it.
4. Repeat the above same process at 30 mins intervals till the difference between two consecutive readings is 1mg. record the lowest weight.

Calculation

$$Total\ ash(\%by\ weight) = \frac{(W2-W)}{W1-W} \times 100$$

Where,

W2 = weight of crucible with ash in g,

W1 = weight of crucible with material taken for test,

W = weight of empty crucible.

Dietary fibre

Reagent

1. Sulphuric acid (0.255 N)
2. Sodium hydroxide (0.313 N)
3. Potassium sulphate (10% solution)

Procedure

About 2 g fat free residue was taken and then transferred to the digestion flask. 200 ml boiling sulphuric acid was added and immediately the flask

was connected to condenser. The flask was heated, boiled by frequently rotating for 30 min. and the volume was maintained with hot water. Then filtered through filter cloth in a fluted funnel. The residue was washed on cloth with hot water or potassium sulphate solution. The residue was returned to digestion flask by washing with hot water, 200 ml boiling sodium hydroxide was added and boiled for 30 min. The volume was adjusted with boiling water, filtered it through the muslin cloth and the residue free of alkali was washed. The residue was transferred into crucible and washed with 15 ml alcohol and the crucible was dried at 110°C for 2 hrs. The crucible was cooled in desiccator and weighed. The crucible was ignited in the furnace at 550°C for 30 min. then cooled and weighed. The loss in weight represented the crude fibre.

$$\text{Crude fibre (\%)} = \frac{w1-w2}{\text{weight of sample}} \times 100$$

Where,

W_1 = Weight of material before ashing (g)

W_2 = Weight of material after ashing (g)

Ascorbic acid

Ascorbic acid content was determined by titration of a known weight of sample with 2, 6-dichlorophenol indophenol dye using oxalic acid. The 2, 6-dichlorophenol dye which is blue in alkaline solution and red in acid solution is reduces ascorbic acid to a colorless form. Ascorbic acid was expressed as mg/ 100g by using given formula.

Dye Factor = 0.5/ Titre

$$Ascorbic\ Acid\left(\frac{mg}{100g}\right) = \frac{Titre \times Dye\ factor \times volume\ made\ up}{Aliquot\ of\ extract\ taken\ for\ estimation \times wt.or\ volume\ of\ sample\ taken\ for\ estimation} \times 100$$

RESULT AND DISCUSSION

Three cultivars viz. Ardhapuri, Grand naine and Mahalakshmi were selected for screening for preparation of banana chips and snacks. Further, these samples were evaluated for their physico-chemical, textural characterstics and sensory qualities.

Degree of angularity plays an important role in the processing. Degree of angularity of Ardhapuri cultivar was 130.33 while Grand naine cultivar was 107.52 and that of Mahalakshmi cultivar was 109.65. Weight of pulp and peel of Ardhapuri cultivar were 107 g and 73 g respectively while Grand naine cultivar were 96.5 g and 65.5 g respectively and that of Mahalakshmi Cultivar were 84.5 g and 38.5 g respectively. Pulp to peel ratio of Ardhapuri cultivar was 1.64, Grand naine cultivar was 1.56 g and that of mahalakshmi cultivar was 2.40 g. Pulp to peel ratio was found more in Mahalakshmi than Ardhapuri and Grand naine.

The edible index and waste index in Ardhapuri cultivar was 59.44 g and 40.56 respectively while Grand naine cultivar was 59.5 g and 40.5 g respectively and that of Mahalakshmi cultivar was 68.37 and 31.53 g respectively . The edible index was found more in Mahalakshmi cultivar than that of Ardhapuri and Grand naine cultivar. The results of present study were in similar with results reported by Molla *et al* (2009).

Chemical Characteristics of banana Fruit:

Chemical properties of fruits represent extent of the perishability as well as suitability for specific product preparation. Moisture play an important role in packaging and storage of banana chips The moisture content of Grand naine cultivar (76.33 %) was slightly higher than Ardhapuri cultivar (75.4 %) and that of Mahalakshmi cultivar (75.76%) . Carbohydrate content of Ardhapuri cultivar was 22.84 per cent while Grand naine cultivar were 23.66 per cent and that of Mahalakshmi cultivar were 23.21 per cent .

Fat is an important factor decide storage period of banana chips as it is important factor to rancidity of oil. Fat was found more in Grand naine (0.39 %) than Ardhapuri (0.33 %) and Mahalakshmi (0.38 %) cultivar. Protein content was found more in Mahalakshmi cultivar (1.11 %) more than Ardhpuri cultivar (1.09 %) and Grand naine cultivar (1.07 %).Ash content was remain slightly changes in it. Dietary fibre decide the nature of texture of banana chips. Dietary fibre was also same only slight differnce in it. Ascorbic acid content of Ardhapuri, Grand naine and Mahalakshmi were 11.0 per cent, 8.7 per cent and 8.9 per cent respectively.

Similar results were reported by Molla *et al* (2009) for different cultivars of Banana.

LITERATURE CITED

AOCC (2000). Approved Methods of the American Association of Cereal Chemists, 10th Ed. AACC, *Journal of Chemometrics*, **20**: 311-320 .

Amin A.N, M.M. Hossain, M.A. Rahim and M.B. Uddin 2015. Determination of optimum maturity stage of banana. *Bangadesh J. Agri Research* **40** (2):189-204.

Amiruzzaman N. 1990. Post harvest handling and processing of fruits and vegetables. Gardening and Homestead productive Activities. CIRDAP. *Journal of food science and technology*, **95**(1):52-56.

Anonymous 1993. Project Profile of Banana Processing, Small Scale Business, Hand Book of Export Oriented Food Processing Projects. Mysore, Central Food Technological Research Institute: 469–470.

Bramwell M.G. and Badrie N. 1973. Chemical composition of unripe and ripe plantain. *Journal of Food Science and Technology*, **24**: 703-707.

Gautam S.K. and Chundawat B.S. 1998. Standardization of technology of sapota wine making. *Industry of Food Packer.* **1**:17-21.

Molla M. M., Alamgir Hossain. M., Nasrin, T. Sheel. S. and Islam M. N. 2007. Study on the preparation of shelf stable ready to serve (RTS) beverages based on bael pulp. *Bangladesh Journal of Agricultural Research.* **32**(4):573-586.

Pethe, Sunita Singh, Kulkarni S.D. and Patel S. 2003. Use of amylase enzyme for clarification of banana beverage, *journal of food science and technology*, **5**: 54-56

Sharma G. K., Madhura, C. V. and Arya, S. S. 1992. Studies on preparation, packaging and storage of besan (Bengalgram flour) burfi. *Joural of food Scencei and Technolgy*., 29:289-292.

Silva *et al* 2009. Study on the Suitability of Banana Varieties in Relation to Preparation of Chips. *Bangladesh Journal of Agricultural Research.* **32**(4):573-586.

Received on 29-04-2020 Accepted on 13-05-2020