International Journal of Chemical Studies

P-ISSN 2349–8528
E-ISSN 2321–4902
IJCS 2016; 4(6): 54-58

Received: 11-09-2016
Accepted: 12-10-2016

Anurag
Department of Agricultural Process and Food Engineering Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Neelesh Chauhan
Department of Agricultural Process and Food Engineering Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Akash Singh
Department of Genetics and Plant Breeding, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, UP, Uttar Pradesh, India

Mahendra Pratap Singh
S.M.S. Crop physiology, KVK Tissuhi Sonbhadra NDUAT Kumargaj Faizabad, Uttar Pradesh, India

Correspondence
Anurag
Department of Agricultural Process and Food Engineering Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Change in physico chemical and microbial attributes of stored banana (*Musa paradisiaca* L.) chips driedunder tray dryer at different temperature and pretreatment of Potassium metabisulfite and Sodium bisulfate

Anurag, Neelesh Chauhan, Akash Singh and Mahendra Pratap Singh

Abstract
This study was done on "Change in physicochemical and microbial attributes of stored banana (*Musa paradisiaca* L.) chips dried under tray dryer at different temperature and pretreatment of Potassium metabisulfite and Sodium bisulfate". Banana chips have become popular across different sections of populations both in urban and rural India. The results of the experiments conducted on the development and quality evaluation of banana chips during storage. Quality evaluation and sensory analysis were analyzed at different storage periods using standard procedures. The quality of the banana chips was evaluated on the basis of physio-chemical characteristics like ascorbic acid (vitamin-C), ash content, protein content, carbohydrate content, and fiber content, secondly, the sensory characteristics were reported on the basis of color, flavor, taste, texture and overall acceptability. All the four samples were packed in the LDPE packages and were analyzed after the preparation and during the ambient storage.

Keywords: Banana, Chips, Moisture content, Ascorbic acid, Protein content, Carbohydrates, Ash content, fiber, Snack foods.

Introduction
Banana is a fruit that is rich in the natural antioxidants such as a vitamin C and vitamin E Someya *et al*., (2002) [6]. Amorim *et al*., (2009a). The antioxidants properties of many fruits are associated with flavonoids and beta- carotenes. Flavonoid is found in the pulp and peel of banana while beta-carotenes are present only in the pulp of some banana varieties (Vijayakumar *et al*., 2008) [5]. It contains 75% is water and 25% dry matter. The fruit is considered an excellent source of Potassium, K (1491mg/100gm). It has an appreciable quantity of Iron, Fe (1.15 mg/100gm), Magnesium, Mg (108 mg/100gm), Phosphorus, P (74 mg/100gm). The production of banana chips is widespread activity in many banana-growing countries. Fried chips should have a moisture content of about 1.5 to 2.0%. The temperature at which the chips are fried and the frying time affects their oil content, appearance, texture, and flavor. The chips must be packed in moisture proof bags to prevent them from absorbing moisture and losing their crispness Thompson, (1995). Chips can be preserved for a long time (months, possibly years) with adequate packaging and storage facilities. Chips are ready-to-eat food and are a favorite among children and adults alike.

Materials and methods
The study was undertaken in food analysis laboratory, Department of Agricultural Engineering and Food Technology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut "Change in physicochemical and microbial attributes of stored banana (*Musa paradisiaca* L.) chips dried under tray dryer at different temperature and pretreatment of Potassium metabisulfite and Sodium bisulfate." the experimental set up and the methodology for the production of control, KMS(Potassium metabisulfite) and NaSHO4 (Sodium bisulfate) sample of whole, fresh unripe banana. The best quality dried product will be stored under ambient storage conditions and packaging materials. Quality parameters in the form of physicochemical and nutrition will be monitored at an interval of one month. All the

All the experiments were conducted in food analysis laboratory in the Department of Agricultural Engineering and Food Technology.

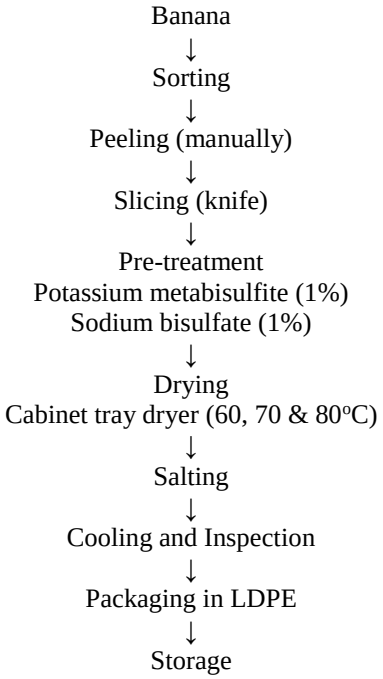

Fig 1: Flow Chart for Preparation of Banana chips

The selection of banana was unripe so as to get the best results and avoiding the further spoilage of the banana. The raw banana was peeled and cut into small pieces to the thickness of 8-12 mm. size and then dipped in the solution using tap water for 4 minutes and then rinsed by tap water in order toremove the rest of the chemical solution from the slice surface. During drying, the tray drying temperatures used will be 60°C, 70°C, and 80°, Jadhav DD, (2010) [3]. Different pre-treatment methods have been developed for fruits drying, among which are lemon which are lemon juice, salt solution, honey dip, ascorbic acid, sulfuring, osmotic pre-treatment, and blanching (Karim, 2005) [1]. Pre-treatment usually performed between preparation and subsequent processing. The raw banana was peeled and cut into small pieces to the thickness of 8-12 mm. size and then dipped in the solution using tap water for 4 minutes and then rinsed by tap water in order to remove the rest of the chemical solution from the slice surface. Two chemicals solution is used in pre-treatment of banana chips was KMS (Potassium metabisulfite) 1%, NaSHO4 (Sodium bisulfate) 1%, One segment of the present study relates to drying. Before drying, some physical and chemical treatments will be given to the samples. Control samples will be also taken. The Physico-chemical analysis includes the study on moisture content, ash content, protein content, carbohydrate, ascorbic acid, and fiber content of the dried banana chips. These were carried out in the Department of Food Analysis Laboratory, SVPUAT, Meerut.

Physico-chemical analysis of dried banana chips

The Physico-chemical analysis includes the study on moisture content, ash content, protein content, carbohydrate, ascorbic acid, and fiber content of the dried banana chips.

Results and Discussion

Control and pre-treated (Potassium metabisulfite & Sodium bisulfate) samples dried and packed in LDPE bags and stored under ambient storage conditions Torrgiani, D and Bertolo, G. (2001) [4]. Quality parameters in the form of physicochemical and sensory will be monitored at an interval of 15 days. According to Katekawa and Silva (2007) [2], drying of bananas is used not only for preservation but also to aggregate value to the product, as in chips. Likewise, Janjai *et al*. (2009) [7] also observed that banana is dried not only for preservation purposes but also for modification of the taste, flavor, and texture to meet consumer preferences and to increase the market value of the product. All the experiments were conducted in food analysis laboratory in the Department of Agricultural Engineering and Food Technology. The banana slices of thickness 8-12 mm size and were treated with Potassium metabisulfite (Potassium metabisulfite)1% and NaSHO4 (Sodium bisulfate) 1% for 4 minutes and then rinsed by tap water in order to remove the rest of chemical solution from slice surface and dried under tray dryer (60, 70 & 80°C). On the basis of the findings of the present investigations, the moisture content was decreased with increase in temperature. The moisture content of Potassium metabisulphite treated banana slice was found to be lowest in cabinet tray dryer at 800C of pre-treatment. Potassium metabisulphite treated banana slice. Controlled banana chips gain the highest Moisture dried at 600C in cabinet tray dryer after 45 days of storage period. Ash content of dried banana chips decreased during the storage period. NaHSO4 treated banana chips losses more ash content day by day in comparison to Potassium metabisulphite treated and controlled banana chips Labuza and Schmidl (1985) [8] suggested moisture absorption of the water vapor present in the air present inside the package. Ash content was found to be highest for controlled banana chips in cabinet tray dryer at 60^0C before storage.NaHSO4 treated banana chips losses more ash content at 80^0C dried in cabinet tray dryer after 45 days of storage. Whereas ash content was found to be highest for controlled banana chips in cabinet tray dryer at 800C after 45 days of storage Ash content of dried banana chips decreased during storage period McCance and Widdwson, (2002). It was found that storage non-significantly affects ash content value ($p>0.05$) at 60^0C and 70^0C. Protein content was found to be highest for controlled, Potassium metabisulphite treated and Sodium bisulfate treated during 0, 15, 30 and 45 days storage period respectively. Protein content 4.32% was found for the controlled sample held at 60^0C before storage (initial stage of storage) and lowest 2.76% was found for the Sodium bisulfate treated dried banana chips held at 80^0C for 45 days of storage period. Potassium metabisulphite treated chips have more protein content than Sodium bisulfate treated, reported that there is the reduction of protein content in pre-treated banana chips. Protein content variations at 60^0C, 70^0C, and 80^0C for controlled, Potassium metabisulphite treated and Sodium bisulfate treated samples were measured during storage. The protein content of all dried banana chips samples non-significantly ($p<0.05$). Carbohydrate was found to be highest for controlled banana chips dried in hot air oven at 60^0C before storage. The carbohydrate was examined from dried banana chips i.e, controlled, Potassium metabisulfite treated and Sodium bisulfate treated) during 0, 15, 30 and 45 days storage period respectively the highest carbohydrate 18.83% was found for the controlled sample held at 60^0C before storage (initial stage of storage) and lowest 15.03% was found for the $NaHSO_4$ treated dried banana chips held at 80^0C of 45 days of storage period. Potassium metabisulfite treated chips have more carbohydrate than Sodium bisulfate treated chips. The ANOVA for carbohydrate variations at 60^0C, 70^0C, and 80^0C for controlled, Potassium metabisulfite treated and

Sodium bisulfate treated samples were measured during storage. Whereas lowest for Sodium bisulfate treated banana chips dried in cabinet tray dryer at 800C after 45 days of storage. The ascorbic acid was examined from dried banana chips i.e, controlled, Potassium metabisulfite treated and Sodium bisulfate treated during 0, 15, 30 and 45 days storage period respectively the highest ascorbic acid 6.82 % was found for the controlled sample held at 60^0C before storage (initial stage of storage) and lowest 3.24 % was found for the Sodium bisulfate treated dried banana chips held at 80^0C for 45 days of storage period. Ascorbic acid of dried banana chips was found in the decreased level. Potassium metabisulfite treated chips have more ascorbic acid than Sodium bisulfate treated chips. ascorbic acid variations at 60^0C, 70^0C, and 80^0C for controlled, Potassium metabisulfite treated and Sodium bisulfate treated samples were measured during storage, fiber content was examined from dried banana chips i.e, controlled, Potassium metabisulfite and Sodium bisulfate treated during 0, 15, 30 and 45 days storage period respectively. The highest fiber content 2.18 % was found for the controlled sample held at 60^0C before storage (initial stage of storage) and lowest 1.16 % was found for the Sodium bisulfate treated held at 80^0C for 45 days of storage period. The fiber content of dried banana chips was found in the decreased level. Potassium metabisulfite treated chips have more fiber content than Sodium bisulfate treated chips. Fiber content variations at 60^0C, 7^{00}C, and 80^0C for controlled, Potassium metabisulfite treated and Sodium bisulfate treated samples were measured during storage. Potassium metabisulfite treated banana chips, rated the highest score for color and taste dried at 70^0C in cabinet tray dryer. Whereas Potassium metabisulfite treated banana chips, the highest score for texture dried at 80^0C in tray dryer after 45 days of storage. Overall acceptability of Potassium metabisulfite treated banana chips dried in cabinet tray dryer at 70^0C were found superior over the others treated and controlled banana chips after 45 days of storage. The revealed that overall sensory quality of dried banana chips depends significantly upon drying methods, pre-treatments, storage period and packaging material.

Thus from studies, it can be concluded that the banana chips pre-treated with Potassium metabisulfite solution dried in cabinet tray dried at (80^0C) exhibited best results over the drying methods. Another pre-treatment i.e. of Sodium bisulfate solution and drying method. Therefore, above pre-treatment and Cabinet Tray drying method could be recommended for drying of banana slices.

Effect of treatments on moisture content at 60^0C, 70^0C, and 80^0C of banana chips in cabinet tray dryer.

Table 1: Changes in moisture content and overall acceptability of banana chips during storage

	60^0C			**70^0C**			**80^0C**		
Storage days	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**
0	7.10±3	6.56±3	6.12±4	6.70±3	6.45±3	6.06±3	6.30±2	6.12±2	6.02±3
15	8.30±3	7.39±3	7.24±3	7.90±3	7.49±4	7.25±2	7.50±3	6.76±2	6.53±3
30	8.68±3	7.86±3	7.19±2	8.10±3	7.98±4	7.39±3	7.98±3	7.29±3	7.18±2
45	8.87±2	8.43±3	8.00±3	8.65±2	8.39±3	7.98±3	8.43±3	7.88±3	7.65±2
CD	N.S.			0.702			0.802		

*CD- critical difference *N.S.-non significance

Effect of treatments on ash content at 60^0C, 70^0C, and80^0C of banana chips in cabinet tray dryer.

Table 2: Changes in ashcontent and overall acceptability of banana chips during storage

	60^0C			**70^0C**			**80^0C**		
Storage days	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**
0	2.45±0.02	2.20±0.03	2.12±0.03	2.21±0.02	2.13±0.03	1.98±0.03	1.96±0.03	1.89±0.02	1.84±0.02
15	2.34±0.03	2.09±0.02	2.04±0.03	2.18±0.04	2.04±0.04	1.80±0.02	1.84±0.03	1.76±0.03	1.71±0.03
30	2.21±0.02	1.86±0.03	1.78±0.04	1.94±0.03	1.81±0.03	1.68±0.03	1.74±0.03	1.63±0.02	1.60±0.03
45	2.05±0.03	1.65±0.04	1.58±0.03	1.79±0.02	1.59±0.04	1.45±0.04	1.53±0.03	1.54±0.04	1.31±0.04
CS	N.S.			N.S.			0.136		

*CD- critical difference *N.S.-non significance

Effect of treatments on protein content at 60^0C, 70^0C, and80^0C of banana chips in cabinet tray dryer.

Table 3: Changes in proteincontent and overall acceptability of banana chips during storage

	60^0C			**70^0C**			**80^0C**		
Storage days	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**
0	4.32±0.03	3.74±0.03	3.72±0.02	4.11±0.03	3.44±0.02	3.37±0.03	4.02±0.03	3.30±0.03	3.21±0.02
15	3.98±0.02	3.42±0.03	3.41±0.03	3.83±0.03	3.26±0.03	3.18±0.03	3.79±0.03	3.12±0.03	3.09±0.03
30	3.71±0.03	3.28±0.02	3.12±0.04	3.45±0.04	3.05±0.03	3.01±0.02	3.31±0.02	2.97±0.02	2.91±0.04
45	3.24±0.03	2.98±0.03	2.79±0.03	3.18±0.03	2.92±0.02	2.88±0.03	3.07±0.03	2.81±0.02	2.76±0.03
CD	N.S.			N.S.			N.S.		

*CD- critical difference *N.S.-non significance

Effect of treatments on carbohydrate content at 60^{0}C, 70^{0}C, and 80^{0}C of banana chips in cabinet tray dryer.

Table 4: Changes in carbohydrate content and overall acceptability of banana chips during storage

	60^{0}C			70^{0}C			80^{0}C		
Storage days	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**
0	18.83±0.11	17.02±0.13	16.79±0.14	17.79±0.13	16.83±0.14	16.89±0.14	16.56±0.12	15.94±0.12	15.67±0.11
15	17.75±0.13	16.89±0.12	16.24±0.12	17.32±0.13	16.32±0.13	17.32±0.13	16.11±0.13	15.56±0.11	15.29±0.12
30	17.12±0.12	16.21±0.13	16.02±0.11	16.92±0.11	16.09±0.11	16.09±0.13	15.87±0.13	15.49±0.11	15.21±0.12
45	16.93±0.11	16.01±0.13	15.87±0.11	16.35±0.11	15.95±0.12	15.81±0.13	15.49±0.11	15.28±0.13	15.03±0.13
CD	N.S.			N.S.			N.S.		

*CD- critical difference *N.S.-non significance

Effect of treatments on ascorbic acid content at 60^{0}C, 70^{0}C, and 80^{0}C of banana chips in cabinet tray dryer.

Table 5: Changes in ascorbic acid content and overall acceptability of banana chips during storage

	60^{0}C			70^{0}C			80^{0}C		
Storage days	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**
0	6.82±3	4.12±2	3.88±2	6.23±2	3.98±3	3.79±3	6.01±3	3.89±4	3.77±3
15	6.21±4	3.87±2	3.71±3	6.02±3	3.78±3	3.62±4	5.87±3	3.72±3	3.58±2
30	6.13±4	3.56±3	3.49±3	5.82±3	3.51±3	3.49±3	5.47±2	3.47±3	3.36±3
45	5.96±3	3.43±3	3.38±4	5.43±2	3.39±2	3.31±3	5.23±2	3.30±3	3.24±2
CD	N.S.			N.S.			N.S.		

*CD- critical difference *N.S.-non significance

Effect of treatments on Fiber content at 60^{0}C, 70^{0}C, and 80^{0}C of banana chips in cabinet tray dryer.

Table 6: Changes in Fiber content and overall acceptability of banana chips during storage

	60^{0}C			70^{0}C			80^{0}C		
Storage days	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**	**T_0 (controlled)**	**T_1 (Potassium metabisulphite)**	**T_2 (Sodium bisulfate)**
0	2.18±0.03	1.40±0.03	1.38±0.03	2.15±0.02	1.37±0.03	1.34±0.03	2.06±0.04	1.34±0.05	1.31±0.03
15	2.04±0.03	1.37±0.03	1.34±0.03	1.95±0.03	1.32±0.03	1.29±0.03	1.82±0.03	1.27±0.04	1.23±0.03
30	1.93±0.02	1.35±0.03	1.29±0.02	1.82±0.02	1.28±0.03	1.20±0.03	1.71±0.03	1.24±0.03	1.19±0.04
45	1.81±0.03	1.27±0.04	1.24±0.03	1.75±0.03	1.21±0.02	1.17±0.02	1.67±0.03	1.20±0.03	1.16±0.03
CD	N.S.			N.S.			N.S.		

*CD- critical difference N.S.-non significance

Microbial evaluation of banana chips.

Data in table 7 shows the results of ambient storage study on TPC of banana chips. Microbial quality was examined by total plate count in fresh and stored samples Akubor PI, Adejo EE (2000) [9]. All banana chips Controlled, Potassium metabisulfite and Sodium bisulfate packed in LDPE Ammawath W, (2002) [10] were evaluated for total plate count for all drying conditions. No colonies were detected in fresh condition as well as after 45 days of storage. Therefore, from the result of the microbial study on TPC may be considered under safe limit even after 45 days of ambient storage.

Table 7: Evaluation of TPC of banana chips during storage

Banana chips during 45 days of ambient storage				
Sample code	**Storage period samples**			
	0 day	**15 day**	**30 day**	**45 day**
Controlled Sample	ND	ND	ND	ND
Potassium metabisulfite	ND	ND	ND	ND
Sodium bisulfate	ND	ND	ND	ND

*Each value is average of 3 determinations *ND: Not detected

References

1. Karim OR. Effect of Pre-treatment on Drying Kinetics and Quality Attributes of Air – Dehydrated Pineapple Slices. Ph.D. Thesis. University of Agriculture, Abeokuta, Ogun State, Nigeria, 2005.
2. Katekawa ME, Silva MA. On the influence of glass transition on shrinkage in the convective drying of fruits: a case study of banana drying, Drying Technology. 2007; 25(10):1659.
3. Jadhav DD, Visavale GL, Sutar PP, Annapurna US, Thorat BN. Drying of bitter gourd: Optimization of pretreatments and quality evaluation. International. ARPN Journal of Engineering and Applied Sciences. 2010; 6(4):105-112.
4. Torrgiani D, Bertolo G. Osmotic pre-treatments in fruit processing: chemical, physical and structural effects. Journal of food engineering. 2001; 49:247-243.
5. Soeya S, Yumiko Y, Okuboob K. Antioxidant compounds from bananas (Mussa Cavendish). Food chemistry. 2002; 79:351-354.
6. Vijaya Kumar S, Prasanna Kumar G, Vijayalakshmi NR. Antioxidant activity of banana flavonoids. Fitoterapic. 2008; 79:279-282.
7. Janjai Janjai S, Lambert N, Intawee P, Mahayothee B, BK Bala, Nagle M. *et al*. J Müller Experimental and simulated performance of a PV-ventilated solar greenhouse dryer for drying of peeled longan and banana Solar Energy. 2009; 83(9):1550-1565.
8. Labuza TP, Schmidl MK. Accelerated Shelf Life Testing of Foods," Food Technology. 1985; 9(2):57-62, 64.

9. Akubor PI, Adejo EE. Physicochemical, microbiological and sensory changes in stored plantain chips. Plant Foods Hum Nutr. 2000; 55:139-146
10. Ammawath W, Che Man YB, Yusof S, Rahman RA. Effects of type of packaging material on physicochemical and sensory characteristics of deep-fat-fried banana chips. Journal of Science Food Agricultural. 2002; 82:1621-1627.