Development of Ripe Banana Powder and It's Fortification in Milkshake

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Abstract

The ripe banana powder was developed from banana slices by optimizing the chemical of pretreatment, time of pretreatment and blanching time with the drying at 60° C for 24 hrs. The various chemical pretreatments such as 0.5 % citric acid, 1% NaCl, 0.3% KMS, 0.45% ascorbic acid and 0.5% citric acid+0.1% NaCl+0.3% KMS were used in the study. The times considered for optimization of chemical pretreatment time was 5, 10, 15, 20 and 25 minutes. The various blanching times used for the optimization of blanching time was 5, 10, 15, 20 and 25 minutes. The suitable chemical for pretreatment, time of pretreatment and blanching time was selected on the basis of sensory evaluation. The developed ripe banana powder was analysed for various physicochemical properties. The result reveled optimized condition for process in terms of blanching of fruits at 60 ^{0}C for 15 minutes and pretreatment to the banana slices with 0.3 % KMS for 10 minutes, followed by drying at 60° C for 24 hrs. The ripe banana powder prepared from developed process was found to be nutrition as rich in carbohydrates, dietary fiber, sugar, energy, minerals and vitamin. The study also concluded that it is also possible to prepared acceptable milkshake by incorporating 15 % ripe banana powder in the milkshake formulation.

Keywords: *Banana, Ripe banana powder, Milkshake, Sensory Evaluation*

1. Introduction

In tropical and subtropical regions Banana is one of the most consumed fruits. It is contributing about 16% of world's total fruit production and is the second largest produced fruit after citrus. India with 16.81 million metric tones annual production, is the leading country in the world in banana production [1]. Banana is very nutritious fruit rich in potassium. It is also an excellent source of vitamins like B6, A, C and D. The new economic strategy is emphasizing on food products waste utilization and converting them into a range of innovative products. Banana is a highly perishable and fruit, and hence needs processing into convenient, stable form. Drying or dehydration brings reduction in volume and weight and thereby minimizing storage, packaging and transportation cost. The powder dried form of food product also enable storability of the product even under ambient temperature and is important from handling and storage point of view, especially in developing countries. Banana powder are thus simple to handle and can be easily incorporated during food preparation and formulation. Ripe banana powder has high content of high level of sugar and carbohydrate. It can be incorporated into food products requiring small quantity of sugar or sweetness and solubility. Therefore it can used in products like noodles, baby foods, milkshake, cake, etc [2]. Converting banana fruit into banana powder is therefore an effective preservation method [3]. Ripe banana powder with physicochemical analysis and it's utilization in products like milkshake is still not researched and hence the present study was undertaken with the aim to develop process technology for making ripened banana powder with following objectives:

- Process optimization for banana powder prepared from ripe banana

- Evaluation of ripe banana powder (Physicochemical Analysis)
- Utilization of developed ripe banana powder in milkshake

2. Materials and Methods [4-9]

Fresh good quality of ripe banana of *Shrimanti* variety was procured from the local market of Jalgaon and firm, mature banana fruits without any defect was selected for study.

2.1: Chemical Pretreatment

The peeled ripened fruit was given various pretreated as t1 (0.5% citric acid), t2 (1% NaCl), t3 (0.3% KMS), t4 (0.45% ascorbic acid) and t5 (0.5% citric acid + 0.1% NaCl + 0.3% KMS) and converted into powder by drying (60°C for 24 hr.). The best pretreatment chemical was selected on the basis of sensory evaluation (9 point Hedonic scale) of these pretreated powder samples.

2.2: Optimization of Pretreatment Time

The two best chemical pretreatment was optimized for the treatment time by pre-treating peeled ripened banana slices with chemical for various treatment time (T5= 5 min., T10= 10 min., T15= 15 min., T20= 20 min. and T25= 25 min.). The optimum time of pretreatment for these two best chemicals pretreatment was selected on the basis of sensory evaluation of their powder.

2.3: Finalization of Best Pretreatment Chemical

On the basis of sensory score of the optimization of pretreatment time for these two selected chemical pretreatment, the most suitable chemical for pretreatment with treatment time, was confirmed.

2.4: Optimization of Blanching Time

Blanching of fruits in hot water as a pretreatment prior to drying can arrest browning as well as reduce the microorganism load present on the surfaces. For the further improvement of the product unpeeled banana was subjected to blanching in hot water (60°C) for various time (T0= 0 min., T5= 5min., T10= 10 min., T15= 15 min. and T20= 20 min.) before the finalized chemical pretreatment. The time for blanching was optimized on the basis of sensory evaluation of their powder.

2.5: Physicochemical Analysis of Developed Ripened Banana Powder

The prepared by using optimized process condition was analysed for various physical (Water absorption capacity, Bulk density, Swelling capacity, Dispersbility, Sieve residue, Angle of repose and yiled) and chemical parameters (pH, ash, crude fiber, fat, protein, carbohydrate etc. minerals and vitamin) using standard methods and instruments.

2.5: Development of Milkshake from Developed Ripened Banana Powder

Milkshake was prepared by incorporating the ripened banana powder at various level (10, 15 and 20 %) in hot milk. The sugar content in ripened banana powder was high therefore sugar was not added. The most suitable level of incorporation of ripened banana powder for milkshake preparation was optimized on the basis of sensory evaluation.

3. Results and Discussions

1.1 Selection of Chemical for Pretreatments Banana Slices

Table 1 indicates the various sensory scores of dried ripe banana slices pretreated with various chemical. Color is very important attribute that influence acceptability of a product by consumer. Pretreatment with t1 and t3 received good acceptance for colour.

The pretreatment with t1 and t3 also shown good result with overall acceptability score 8 and 8.6 respectively. Hence 0.5% citric acid and 0.3% KMS pretreatment was selected for further process development.

Table 1. Sensory Evaluation of Dried Ripe Banana Slices Pretreated with Various Chemicals

Parameters	t1	t2	t3	t4	t5
Flavor	8.3	7	8.6	6.3	6.6
Color	8	7.3	9	6.3	8.3
Texture	8	7.3	8.3	7	7.3
Appearance	7.6	7.6	8.3	7.3	7.3
Taste	7.6	6.6	8.3	7.3	6.3
Mouth feel	7	7.3	8	7	6.6
Chewiness	7.3	6.3	7.6	6	7
After Taste	7.3	6	8	7	5.6
Overall Acceptability	8	7.3	8.6	7	7

(Values are Means of 10 Sensory Score)

1.2 Selection of Chemical Pretreatment Time for Banana Slices

Table 2. Sensory Evaluation Result of 0.5% Citric Acid Treated Dried Ripe Banana Slices for Different Pretreatment Times

Parameters	T5	T10	T15	T20	T25
Flavor	7.3	7.3	7.3	7	6
Color	6.6	7	7.3	7.6	7.6
Texture	6	7.3	7.6	8	7
Appearance	6	7.6	7.3	7.3	7.3
Taste	7.3	7.6	7.6	6	5.6
Mouth feel	7	7	7.3	6.6	5.3
Chewiness	6	6	6.3	6.3	6.6
After Taste	6	6	5.6	5.3	5
Overall Acceptability	6	7	7.3	7	6.6

(Values are Means of 10 Sensory Score)

Sensory score of 0.5% citric acid treated dried ripe banana slices at different pretreatment times is shown in Table 2. Powder with pretreatment time 15 minutes was majorly acceptable by panelists with 7.3 color score, 7.6 taste score and with 7.3 overall acceptability score. As the 15 minutes pretreatment powder was better than other in colour and .taste and hence optimized for 0.5% citric acid treatment.

Table 3 designates the sensory score for dried ripe banana slices treated with 0.3% KMS (Potassium Metabisulphite) solution from time T5 to T20 (5 minutes to 20 minutes). Table shows that the time T10 was majorly acceptable by panelists with 8.5 overall acceptability score. The color, mouth feel, taste of the sample of pretreatment time 10 min. was good as compare to others. The time 10 minutes was therefore optimized for 0.3% KMS pretreatment.

Table 3. Sensory Evaluation Result of 0.3% KMS Treated Dried Ripe Banana Slices for Various Pretreatment Time

Parameters	T5	T10	T15	T20
Flavor	8	8.6	8	7.6
Color	7.6	9	8.3	8.3
Texture	8.3	8.3	7	6.6
Appearance	7.6	8	7.3	6.6
Taste	7.6	8.5	7.6	7
Mouth feel	7	8.5	8	7.3
Chewiness	7.6	8	8	7.6
After Taste	7.6	8.3	7.6	7
Overall Acceptability	8	8.5	8	7.3

(Values are Means of 10 Sensory Score)

1.3 Selection of Most Suitable Pretreatment Chemical for Banana Slices

In the finalization of best pretreatment chemical for banana slices the sensory score of 0.5 % citric acid pretreatment for 15 min. and 0.3 % KMS pretreatment for 10 min. was compared. The dried banana slices treated with 0.5% citric acid was found to show moderate brownish color, loose firmness of texture and was not much acceptable by panelist as compare to 0.3% KMS pretreatment which was showing slight brown color (due to more prevention of enzymatic browning) and good firmness of texture. The pretreatment of ripened banana slices with 0.3 % KMS for 10 minutes was hence finalized.

3.4: Blanching Time Optimization for Banana Slices

Table 4. Sensory Evaluation Result of 0.3% KMS Treated Ripe Banana Powder for Different Blanching Time

Parameters	T0	T5	T10	T15	T20
Flavor	5.3	6	6.3	7.6	8
Color	5	5.3	6	8.6	7.6
Texture	5.3	6.3	7	8.6	8.3
Appearance	5.3	6.3	7	8.3	7.6
Taste	5.3	5.3	6.3	8.3	7.3
Mouth feel	5.3	6	6.6	8.3	7.6
Chewiness	5.6	6	6.6	8.6	7.6
Overall Acceptability	5.3	6	6.3	8.0	7.6

(Values are Means of 10 Sensory Score)

Table 4 indicates the result of various blanching treatment time given to banana slices. The result reveled 15 minutes blanching time to be optimum as product retained good sensory (good texture and good color) as indicated by high sensory score for texture (8.6 score) and colour (8.6 score) and other parameters, including overall acceptability (8.0 score).

3.5 Finalized Process for Ripe Banana Powder

Figure 1 shows the process sequence along with the finalized process parameter for the preparation of Ripe Banana Powder.

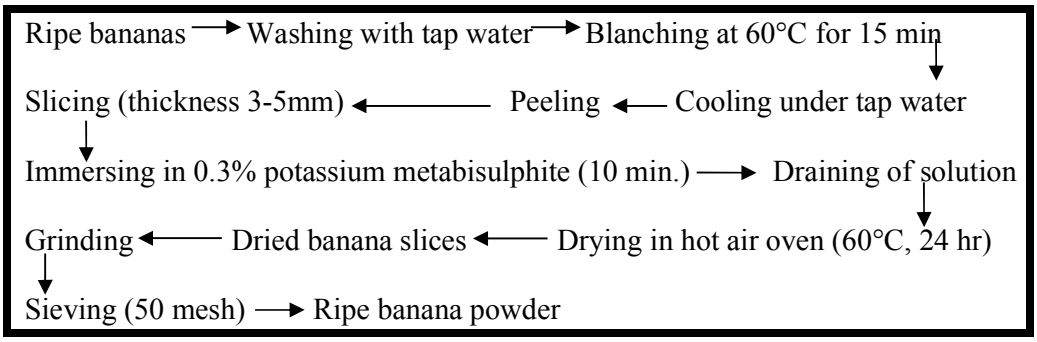

Figure 1. Flowchart for Optimized Process of Ripe Banana Powder

3.6: Result of Physical and Functional Characteristics of Developed Ripe Banana Powder

Table 5 shows the physical and functional properties of ripe banana powder. High water holding property implies the potentials of banana powder to be used as a thickener in liquid and semiliquid foods. Also WAC is directly proportional to solubility [10]. The yield obtained was 29.98 %.

Table 5. Physical Characteristics of Ripe Banana Powder

Parameters	Value
Water absorption capacity (g/g)	2.96±0.04
Bulk density (g/ml)	0.744±0.01
Water solubility index	0.98±0.27
Swelling capacity (ml/g)	3.25±0.18
Dispersibility (%)	87±0.02
Sieve Residue (g/100 g)	7.8±0.53
Angle of repose (°)	26.66±0.02
Yield (%)	29.98±0.23

(Values are means of 3 determination ± standard deviation)

3.7: Result of Chemical Analysis of Developed Ripe Banana Powder

Table 6. Result of Chemical Analysis of Ripe Banana Powder

Parameters	Value	Parameters	Value
Moisture (%)	7.70±0.81	Non reducing sugar (%)	8.67±0.05
pH	6.86±0.01	Insoluble dietary fiber (%)	7.24±0.02
Ash (%)	4.4±0.08	Soluble dietary fiber (%)	0.7±0.12
Crude fiber (%)	0.88±0.03	Total dietary fiber (%)	7.94±0.21
Fat (%)	1.03±0.05	Calcium (mg/100g)	79±0.13
Protein (%)	3.61±0.19	Iron (mg/100g)	5±0.05
Carbohydrate by difference (%)	81.99±0.04	Potassium (mg/100g)	1494±0.11
Energy (cal)	358.75±0.08	Magnesium (mg/100g)	189±0.12
%Acidity (Malic acid)	0.23±0.01	Sodium (mg/100g)	3.8±0.04
%Acidity (Citric acid)	0.22 ±0.01	Phosphorus (mg/100g)	290±0.15
Total sugar (%)	31.07±0.07	Vit C (mg/100g)	5.43±0.08
Reducing sugar (%)	22.4±0.03	Non reducing sugar (%)	8.67±0.09

(Values are means of 3 determinations ± standard deviation)

Table 6 represents the result of the chemical analysis of developed banana powder.

The result shows that the developed ripe banana powder was nutritious and healthy as rich in carbohydrates, dietary fiber, sugar, energy, minerals and vitamin.

3.8: Result of Incorporation of Developed Ripe Banana Powder in Milk for Milkshake Development

Table 7 shows the sensory score for milkshake incorporated with various level of developed ripe banana powder and confirmed 15% level to be most suitable because of the enough smoothness and enough sweet taste which was not required externally addition of sugar.

Table 7. Sensory Evolution Result of Milkshake Incorporated With Different Level of Ripe Banana Powder

Parameters	10%	15%	20%
Flavor	8	8.3	7.6
Color	7.6	8.6	7.6
Appearance	8	9	6.6
Taste	7.3	8.6	6.6
Consistency	7	9	5.6
Mouth Feel	7.6	9	5.6
Overall Acceptability	8	8.6	6.3

(Values are Means of 10 Sensory Score)

4. Conclusion

It is possible to prepare acceptable quality ripened banana powder, however need blanching of fruits at 60 ^{0}C for 15 minutes, pretreatment to the banana slices with 0.3 % KMS for 10 minutes, followed by drying at 60 ^{0}C for 24. hr. The ripe banana powder prepared from developed process was nutrition as rich in carbohydrates, dietary fiber, sugar, energy, minerals and vitamin. It is also possible to prepared good enough milkshake by incorporating 15 % ripe banana powder in milk.

5. References

[1] H. P Singh, S. Uma, "Genetic Diversity of Banana in India: Prooceedings of the Conference on Challenges for Banana Production and Utilization in 21st Century", Trichy, **(1996)**

[2] S. Gamlath, "Impact of Ripening Stages of Banana Flour on the Quality of Extruded Products", International Journal of Food Science and Technology vol. 43, no. 9, **(2008),** pp. 1541-1548.

[3] Y. C. Muzanila, V. Mwakiposa, "Assessment of Nutritional Status of Traditionally Prepared Banana Flour Khenyangwa African Crop Science Conference Proceedings", Sokoine University of Agriculture, vol. 6, **(2003)**, pp.564-567.

[4] AOAC **(1990),** Official methods of analysis (15thedn). Washington DC. Association of Official Analytical Chemists.

[5] S. O. Agunbiade, J. O. Olanlokun, and O. A. Olaofe, "Quality of Chips Produced from Rehydrated Dehydrated Plantain and Banana", Pakistan Journal of Nutrition, vol. 5, no. 5, **(2006)**, pp. 471-473.

[6] K. A. Taiwo, "Influence of blanching on the drying and rehydration of banana slices", African Journal of Food Science, vol. 3, no. 10, **(2009)**, pp. 307-315.

[7] E. E. Abano and L. K. Sam-Amoah, "Effects of Different Pretreatments on Drying Characteristics of Banana Slices", APRN Journal of Engineering and Applied Science, vol. 6, no. 3, **(2011),** pp. 121-129.

[8] Ravindar sing, S. Ranvir and S. Madan, "Comparative Study of the Ripe Banana Flour, Unripe Banana Flour and Cooked Banana Flour Aiming Towards Effective Utilization of These Flours", International Journal of Current Microbiology and Applied Science, vol. 6, no. 8, **(2017)**, pp. 2003-2015.

[9] Juan Wang, Hui Hua Huang and Ping Sheng Chen, "Structural and Physiochemical Properties of Banana Resistance Starch From Four Cultivers", International Journal of Food Properties, vol. 20, no. 6, **(2017)**, pp. 1338-1347.

[10] S. Pragati, I. Genitha, K. Ravish, "Comparative Study of Ripe and Unripe Banana Flour during Storage", J Food Process Technol vol. 5, no. 11, **(2014),** pp 1-6.