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Impact of Osmodrying on Qualitative Properties of Fruits Viz. Pineapple Cube, Apple Cube and Banana Slice

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Abstract

Nowadays osmodrying is proved to be an efficient technique of processing and preservation of fruits and vegetable varieties. The process of osmodehydration can promote the suitability of processing of various categories of fruits and vegetable produce with retention of organoleptic and nutritional characteristics. The aim of this project work is to prepare osmodried fruit cubes with satisfactory health benefits and good organoleptic acceptance. To carry out the project work, apples, banana and pineapple of fresh quality was purchased from local market adjacent to the institution. Now these fruits were blanched, peeled and were formulated using different concentrations of sugar solutions viz. 60%, 65% and 70% respectively. The dehydrated fruits were then subjected to physico-chemical and microbiological analysis. The chemical quality indexes viz.moisture, ash, fat and sugar were analyzed for the osmodried products. For osmotically dehydrated apple, pineapple and banana cubes, the estimated moisture ,ash, fat and sugar content were found as 77%, 77.64%, 79.24% ;0.12%, 0.06%, 0.08%; 0.1%, 0.07%, 0.08%; 24.2%, 25%, 26.5% and 10.71%, 17.25%, 10.76%; 0.1%, 0.12%, 0.01%; 0.001%, 0.002%, 0.02%; 28%, 29.60%, 30% and 16%, 13.37%, 13.97%; 2%, 2.2%, 2.6%; 0.005%, 0.01%, 0.01%; 18%, 20.30%, 21.70% with respect to preservation in 60%,65%,70% sugar syrup respectively. Microbiological analysis of osmodried apple, pineapple and banana revealed that negligible count of yeast and mold occurred at an incubation temperature and time of 37 degree centigrade for 72 hours with an optimum sugar concentration of 70%.Sensory evaluation in terms of appearance, color, flavor, body, mouthfeelness and overall acceptability of pineapple cube, apple cube and banana slices in different sugar concentrations viz. 60%, 65%, 70% were studied. Therefore in this study 70% sugar solution was proved efficient for osmodehydration in terms of its nutritional and organoleptic significance.

Keywords: Osmodried fruits, Preservation, Nutritional quality, Sensory characteristics, Utilization.

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Contents

1. Introduction

Osmodrying as a food preservation technique involves the addition of highly concentrated solution of osmotic agents e.g. sugar, salt into the food materials. Fruits and vegetables dehydrated slightly can be added to various kinds of dairy products as well as bakery and confectionary items. Finally the food materials are dried completely and can be considered as suitable components of cereal based products [1]. Various process parameters involving in drying process as well as constituents responsible for osmosis can affect greatly on the nutritional and other quality attributes of osmotically dehydrated fruits and vegetables [2, 3]. Though there is a significant loss of various nutrients during dehydration but at the same time the dried food materials enriched with concentrated solutions caused for osmosis can greatly increase its dietary value apart from its organoleptic properties. Human health is highly benefited by the consumption of processed dehydrated fruits due to the potential availability of various microelements as well as antioxidants, soluble dietary fibers and also provides significant amount of energy where it is produced by osmosis by the application of concentrated sugar solution followed by dehydration as a result of convective air current. The process restricts the appearance potential of osmodried fruit items where consumers like weighty one. Suitable alternatives of sucrose e.g. glucose, trehalose, polyols, fruit juice concentrate and different carbohydrate mixtures as osmotic agent has been tested and proved as potential osmotic substances though the knowledge about the influence of these substances on taste as well as organoleptic attractivity is unknown [4-8]. The process of osmosis results the elimination of water along with little amount of acid from fruits and vegetables where the semipermeable cell membrane can only permit water in comparison to sucrose which penetrates rapidly with respect to time. Various factors e.g. temperature, concentration of sugar syrup as well as solution of osmotic agent, time etc. greatly influence the osmodried fruits and vegetable based product characteristics [9].These osmodried fruits have varied applications in various sweet dish preparations such as ice-cream, custard, pudding etc. One such application which was performed during this research work was the preparation of custard with osmo-dried fruits. The spoilage opportunity of fruit is more due to occurrence of more than 70% water. Therefore proper storage as well as dehydration is the suitable way of keeping such kind of food materials for longer period. The mechanism of osmosis in fruit pieces involves the water migration because fruit pieces consisting of sucrose and other constituents where the structural entity of cells functions like effective semi-permeable membrane. According to Pointing, et al. [10] the influence of slight drying of fruit slices in sucrose solution reveals that the maximum extent of water removal will be 50% of the initial weight of different fruits like banana, papaya, mangoes and apples.

1.1. Qualitative Upgradation of Food Product

Osmosis followed by convective drying is always preferred to obtain the good quality of food product. According to several studies it has been observed that the sensory qualities of e.g. color, flavor and texture of food product is significantly enhanced by osmodrying [10, 11].

1.2. Energy Efficicacy

Osmotic drying process is economical in use in juice and beverage industries because of less consumption of energy in comparison to other conventional drying process. The process of osmosis reduces water activity and extend the shelf stability thereby preserve the food products in a way where only drying process needs more amount of energy and can be avoided. The resultant osmotic solution can be used in juice or beverage industries as a product, improving process economy, or it may be re-concentrated for further drying.

1.3. Reduction of Cost

Due to ease of handling and transport to market the packaging and distribution cost of osmodried food products is significantly reduced. According to Biswal [12] it has been observed that successive osmodrying and freezing of fruits and vegetables can save packaging and distribution costs effectively.

1.4. Preservation without Chemical Treatment

Canned fresh apple slices can be well preserved by the addition of texture modifier e.g. calcium chloride [13]. Osmo-canning process employed for apple slices results firmer texture and qualitative improvement. Osmotic process discourages the reduction of enzymatic browning by using chemical [10].

1.5. Storage Stability of Osmodried Product

Osmosis results better storage stability of fruits and vegetables than its untreated counterpart due to reduced level of water activity which lowers the extent of chemical reaction and the growth of toxin-producing micro-organisms in the food. Canning of fresh fruit and vegetable consisting of high moisture causes flavor reduction by dilution of sugar syrup with product water. Osmo-canning process can suitably improve the storage stability of product and can prevent the flavor loss.

1.6. Limitations of Osmotic Dehydration Process

Addition of acid extracted from fruit in solution causes osmosis may overcome the problem of lowering of acidity [10].According to Lenart and Flink [1] osmodrying has been proved as a suitable alternative of other processes like sulphitation of fruits or blanching in comparison to enzyme activation as well as textural defects. Syrup management strategy must be improved to overcome the problem in industrial application

1.7. Selection of Raw Materials for Osmodrying

1.7.1. Internal Properties of Raw Material

The process of osmosis is governed by several controlling parameters including the variety, maturity, solube and insoluble solid content, intercellular spaces and most importantly enzymatic activity but solute concentration as well as process temperature has no effect on the gain of solid rate kinetics.

1.7.2. Morphology and Dimensions of Fruit Slices

Loss of water during process of osmosis has a significant impact mainly adverse effect on the product morphology related to surface area [14]. It has been observed [11] that the partition coefficient of water into solute particles decreased with the increment of surface area, temperature, syrup concentration and thickness as morphological parameter. Generally the dimension ranges from (3-10) mm was suggested of different shapes e.g. rectangular, circular or cubical for osmodrying treatment.

1.7.3. Pretreatment for Osmosis

Pretreatment techniques like blanching or freezing has an adverse effect i.e. qualitative deterioration before the loss of water during osmosis. Different types of color degradation phenomena including enzymatic browning, discoloration etc. can be restricted by the addition of 1% citric acid,sulphur dioxide and acidic or alkaline solution of esters made of oleate before drying as well as osmodrying [15, 16]. A high quality osmodried food products based on papaya, mango slices etc. can be prepared by pretreatment with 0.4% ascorbic acid solution or 0.4 % ascorbic acid + 0.1% KMS solution for 30 min time exposure.

1.7.4. Dipping Time

A significant increase in elimination of water occurs due to rise in deeping time where solution concentration remains constant. It has been observed generally the maximum major solute migration took place within two hours of osmosis. According to Tiwari and Jalali [17] the rate decrement of osmodrying in mango and pineapple affects the increase in weight loss. According to the investigation [18, 19] it has been reported that osmodrying occurs at 50^{0}C for 3 hrs deeping time shown optimum level of water elimination and gain of sucrose as compared with 70^{0}C for same duration.

1.7.5. Materials Required for Osmosis

It has been observed from several reports that osmodrying process for fruits chiefly and vegetables can be suitably governed by materials viz. sugar, glucose, calcium chloride, monohydroxy ethanol and polyhydroxy compounds such as lactose, malt dextrin, corn syrup and mixtures and sodium chloride respectively.

1.7.6. Stirring/Mixing

The rate of process of osmosis will be rapid during well stirred as well as mixed fruits with sugar syrup due to reduced mass transfer resistance (K_L) which causes defect. It has also been observed [14, 19] that there is a significant effect of mixing speed on elimination of water.

1.7.7. Fruit Slices to Osmotic Agent Ratio

An optimum ratio is always maintained to achieve a good result. Therefore conventionally in practice according to Tiwari [19] a ratio of 1:2 or 1:3 is optimum.

1.7.8. Mass Transfer Phenomena during Osmotic Dehydration

In osmodehydration process followed by concentration development three major types of counter current mass transfer is suggested [19, 20]. A series of phenomena including water out flow from product to solution, a solute migration e.g. preservative, nutrients etc., improvement of organoleptic quality as well as leaching out of various solutes e.g. sucrose, organic acids, minerals, vitamins etc occurs during osmodehydration process.

2. Materials and Methods

To carry out the project work, apples, banana and pineapple of fresh quality was purchased from Kokrajhar Market, Assam adjacent to the institution. The manufacturing flow diagram is suitably indicated in Figure 1.
Collection and sorting, grading of fruits.

2.1. Utilization of Osmodried Fruits

One of the suitable applications of osmodried fruits was done by the preparation of custard. The manufacturing flow diagram is indicated Figure 2.

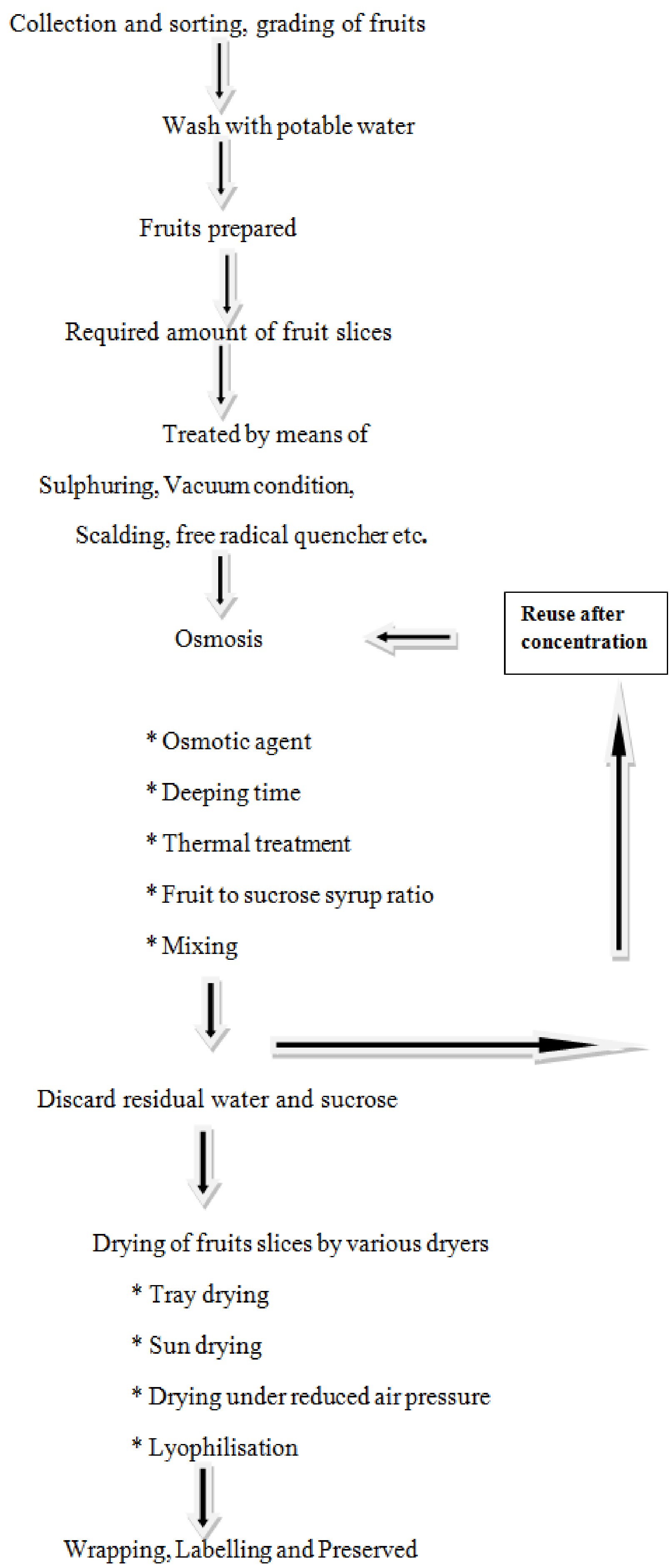

Figure-1. General manufacturing flow diagram of Osmodried fruits.
Source: Subhajit Ray,2019.

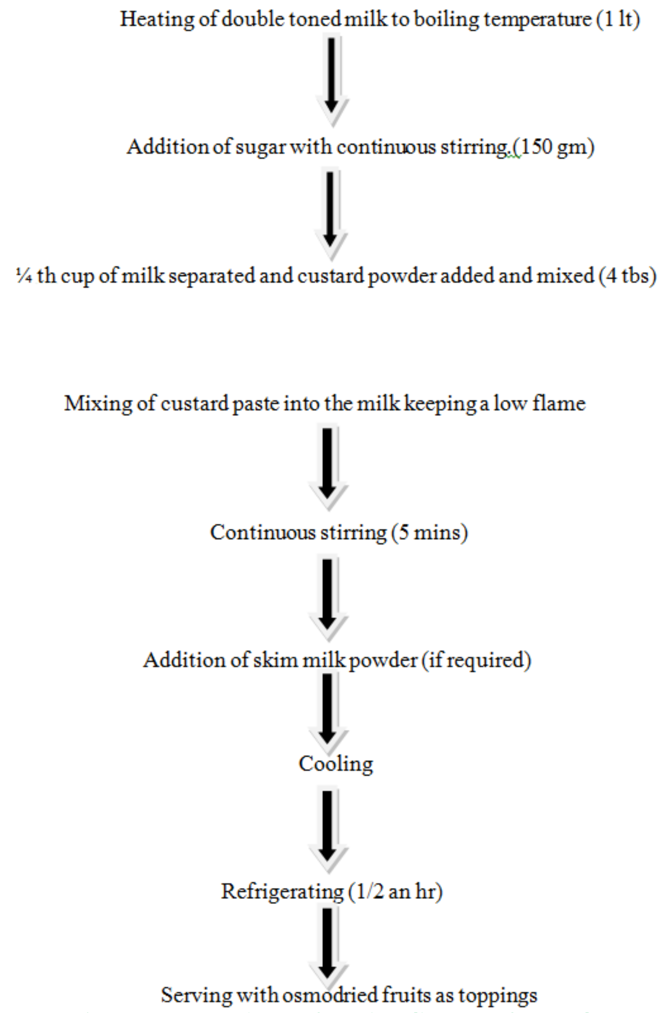

Figure-2. General manufacturing diagram of custard.

Source: krishikosh.egranth.ac.in.

Refrigerated milk based product mixed with custard powder and finally Osmodried fruit cubes are placed in the surface as topping material for display as well as sensory acceptability.

2.2. Sensory Evaluation

Sensory characteristics of osmodehydrated fruits (apple, pineapple, banana) were assessed by a group of trained panelists by using nine point hedonic rating test. The nine point hedonic rating scale is considered as standardas followed by sensory panel in any sensory evaluation study [21].

2.3. Determination of Chemical Quality Parameters

Moisture content, fat content, ash content and carbohydrate content of osmodried fruits was measured using AOAC [22] procedure.

2.4. Microbiological Examinations of Osmodried Fruits

Microbiological analysis of the osmodried fruits were carried out using Salle [23].

3. Result and Discussions

3.1. Proximate Composition of Osmodried Fruit

Table-1. Evaluation of chemical quality of Osmodried apple cube.

% Sugar concentration	Moisture (%)	Ash (%)	Fat (%)	Carbohydrate (%)
60	77	0.12	0.1	24.2
65	77.64	0.06	0.07	25
70	79.24	0.08	0.08	26.5

Source: Subhajit Ray,2019.

From Table 1 it was found that after osmo dehydration of apple cube with sugar solutions of 60%,65%,70% concentration, the estimated moisture ,ash, fat and sugar content were found as 77%,77.64%,79.24%; 0.12%,0.06%,0.08%; 0.1%, 0.07%, 0.08%; 24.2%,25%,26.5.

Table-2. Evaluation of chemical quality of Osmodried pineapple cube.

% Sugar concentration	Moisture (%)	Ash (%)	Fat (%)	Carbohydrate (%)
60	10.71	0.1	0.001	28
65	17.25	0.12	0.002	29.6
70	10.76	0.01	0.02	30

Source: Subhajit Ray,2019.

From Table 2 it was found that after osmo dehydration of pineapple cube with sugar solutions of 60%,65%,70% concentration, the estimated moisture ,ash, fat and sugar content were found as 10.71%,17.25%,10.76%; 0.1%,0.12%,0.01%; 0.001%,0.002%,0.02% ;28%,29.60%,30%.

Table-3. Evaluation of chemical quality of Osmodried banana slice.

% Sugar concentration	Moisture (%)	Ash (%)	Fat (%)	Carbohydrate (%)
60	16	2	0.005	18
65	13.37	2.2	0.01	20.3
70	13.97	2.6	0.01	21.7

Source: Subhajit Ray,2019.

From Table 3 it was found that after osmo dehydration of banana slice with sugar solutions of 60%,65%,70% concentration, the estimated moisture ,ash, fat and sugar content were found as16%,13.37%,13.97%; 2%,2.2%,2.6%; 0.005%,0.01%,0.01%; 18%,20.30%,21.70%.

Table-4. Microbiological analysis of osmodried fruits.

Products	Concentrations(%)	Microbial count of Yeast and Mold at 37 Degree Centigrade (cfu/gm)
		Finished Product
Pineapple	60	57-63
	65	negligible
	70	negligible
Apple	60	34-36
	65	10-12
	70	negligible
Banana	60	78-87
	65	72
	70	24-29

Source: Subhajit Ray,2019.

It is observed from Table 4that after osmo dehydration of first fruit viz.pineapple cubes with sugar solutions of three different concentrations, pineapples dehydrated using 65% and 70% sugar concentration shows negligible growth of yeast and moulds when incubated at 37 degree centigrade for 72 hours. Similarly apple cubes dehydrated using70% sugar concentration shows negligible growth of yeast and mold. In case of banana slice 70% sugar concentration was found comparatively better than the other two concentrations as compared with growth of yeast and mold.

3.2. Comparison of Sensory Evaluation Datas Using Bar Diagram

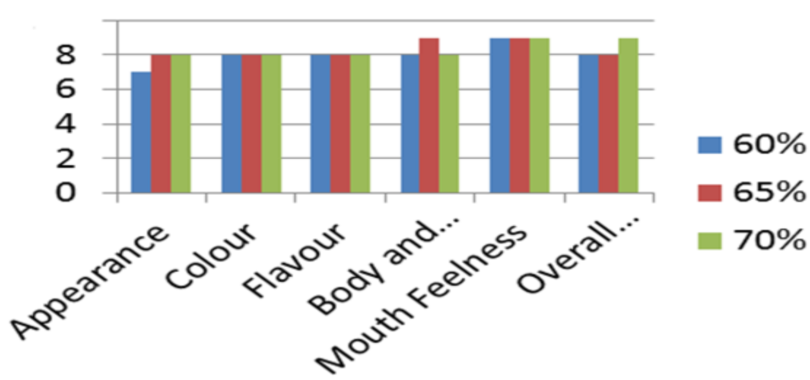

Figure-3. Evaluation of sensory characteristics of osmodried Apple by semi-trained panel of judges.
Source: Subhajit Ray,2019.

From Figure 3 it is evident that the appearance of osmotically dehydrated apple cube with 60% sugar concentration is a little low as compared to the other concentrations. Apple dehydrated using 65% sugar concentration was found to be acceptable organoleptically with all respect as compared to the other two samples of apple dehydrated osmotically using 60% and 70% sugar concentration respectively.

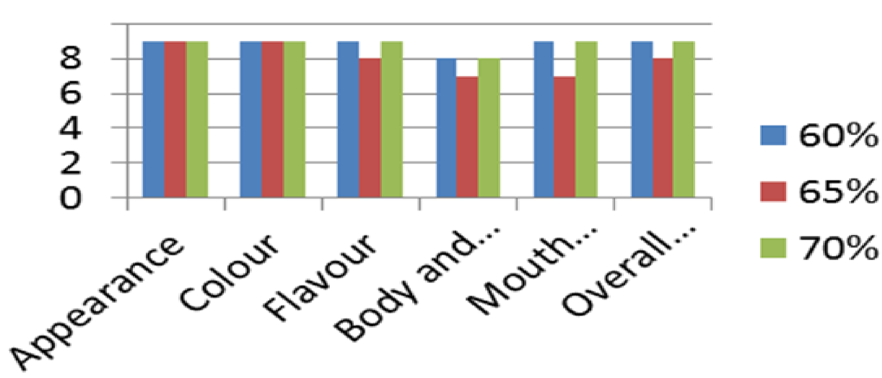

Figure-4. Evaluation of sensory characteristics of osmodried Pineapple by semi-trained panel of judges.
Source: Subhajit Ray,2019.

From Figure 4 it can be observed that pineapple cube dehydrated osmotically using 60% and 70% sugar concentration was found to have a good overall acceptability. But in case of the pineapple cube dehydrated using 65% sugar concentration the body and texture was not satisfactory and it also result a poor mouthfeelness.

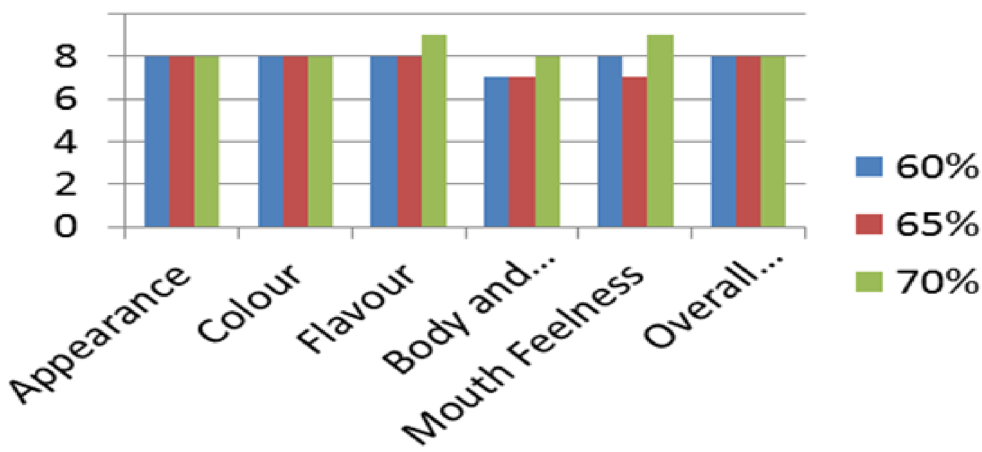

Figure-5. Evaluation of sensory characteristics of osmodried Banana by semi-trained panel of judges.
Source: Subhajit Ray,2019.

From Figure 5 it was seen that the results on sensory analysis for banana slice after osmotic treatment viz.60%, 65% and 70% sugar solution respectively showed a marked decrease in the body and texture of the product compare to other evaluated datas.

4. Conclusions

Osmodrying was performed to extend the shelf stability of fruit slices by using three different concentrations of sugar solutions viz.60%, 65%, and 70% respectively on three fruits viz. Apple, Pineapple and Banana. The moisture, ash, fat and sugar analysis were performed for the final dehydrated products and the values were reported. For osmotically dehydrated apple, pineapple and banana cubes, the estimated moisture ,ash, fat and sugar content were found as 77%,77.64%,79.24%; 0.12%,0.06%,0.08%; 0.1%, 0.07%, 0.08%; 24.2%,25%,26.5% and 10.71%,17.25%,10.76%; 0.1%,0.12%,0.01%; 0.001%,0.002%,0.02% ;28%,29.60%,30% and 16%,13.37%,13.97%; 2%,2.2%,2.6%; 0.005%,0.01%,0.01%; 18%,20.30%,21.70% with respect to preservation in 60%,65%,70% sugar syrup After performing the microbiological analysis of dehydrated fruits it can be seen that after osmo dehydration of pineapple with sugar solutions of three different concentrations, pineapples dehydrated using 65% sugar syrup and 70% sugar syrup shows negligible growth of yeast and moulds when incubated at 37 degree centigrade for 72 hours. Similarly apples dehydrated using70% sugar syrup shows negligible growth of yeast and mould. In case of banana 70% sugar concentration was found comparatively better than the other two concentrations as compared with the count of yeast and mould. Therefore it can be concluded that for all the three fruits 70% sugar solution was found optimum for osmodehydration .Experimental results also revealed that osmotically dehydrated fruit prepared by finite concentration of sugar syrup not only improve it's shelf stability but also enhances nutritional value and sensory characteristics.

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