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Development of Fruit Bar by Using Apple and Banana Pulp Supplemented with Omega-3 Fatty Acid

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ABSTRACT

The present experiment was done to make fruit bar using apple and banana pulp which was supplemented with omega-3 fatty acid. The objective of study was to evaluate physio-chemical, microbial, organoleptic parameters along with estimation of cost of fruit bar. From experiment it was found that fruit bar with 99% pulp and 1% omega-3 fatty acid was found to be best in every aspect of organoleptic analysis, microbial, physio-chemical analysis as well as antioxidant activity followed by fruit bar containing 2% and 3% omega-3 fatty acid.

Keywords-fruit bar, omega-3 fatty acid, antioxidants.

INTRODUCTION

Fruit bar is a concentrated fruit product with good nutritive value.Fruit bars are high calorie foods and are a rich source of the vitamins and minerals. It is classified as a confectionary product with longer shelf life.Fruit bar means the product prepared by blending pulp/puree from sound ripe fruit, fresh or previously preserved nutritive sweeteners, butter or other vegetable fat or milk solids and other ingredients appropriate to the product and dehydrated to form sheet which can be desired shape or size.Fruit bars are also produced from the pulp of fresh fruits. They are manufactured hygienically, are attractively packed and are easy to transport.

The fruit bars or fruit-slabs or fruit-leathers are the terms used for the products prepared by dehydration of fruit pulps. Mango, banana, citrus, guava, grape, pineapple, and apple are the major fruits out of which a good quality fruit bar/candy can be prepared. The fruit pulp has been dehydrated to form fruit leathers/bar or candy with addition of sugar, acid and other ingredients. In our experiment we used apple and banana pulp to make fruit bar supplemented with omega-3 fatty acid. Apple is the pomaceous fruit of the apple tree, species ***(Malusdomestica)*** in the rose family (Rosaceae). Apples are rich in antioxidant, phyto-nutrients, flavonoids and polyphenolics. Some of the important flavonoids in apples are quercetin, epicatechin, and procyanidin B_2. Additionally, they are also good in tartaric acid that gives tart flavour to them. Apple fruit contains good quantities of Vitamin-C and beta-carotene. Vitamin C is a powerful natural antioxidant. Apple is also a good source of B-complex vitamins such as riboflavin, thiamine and pyridoxine. Banana ***(Musaparadisiaca)*** is a good source of potassium, vitamins and minerals. The fruit is one of the high calorie tropical fruits. 100 gm of fruit provides 90 calories. Besides, it contains good amounts of health benefiting anti-oxidants, minerals, and vitamins. Banana pulp is composed of soft, easily digestible flesh with simple sugars like fructose and sucrose that when eaten

replenishes energy and revitalizes the body instantly; thus, for these qualities, bananas are being used by athletes to get instant energy and as supplement food in the treatment plan for underweight children. Banana contains several vitamins such as vitamins A, B and C. The fruit is an also moderate source of Vitamin-C.

Omega-3 polyunsaturated fatty acids have been identified as providing potential health benefits when consumed regularly at appropriate concentration.Omega-3 fatty acids, EPA and DHA are essential and must be obtained from diet. It accounts for 97 percent of the omega-3 fats in the brain. There are now many foods, beverages and supplements available that are fortified with a vegetarian and sustainable, algal-based source of DHA. Algal DHA provides brain, eye and heart health benefits.

Thus the present experiment was performed with aim to evaluate the physico-chemical properties of fruit bar supplemented with omega-3 fatty acids, to analyze the sensory and microbiological parameters of fruit bar supplemented with omega-3 fatty acids and to estimate the cost of the fruit bar supplemented with omega-3 fatty acids.

MATERIALS AND METHODS

The experiment **"Development of fruit bar by using apple and banana pulp supplemented with omega-3 fatty acid"** was conducted in the Student Research Laboratory, Warner School of Food and Dairy technology, SHIATS, Allahabad (U.P.).
Apple was collected from the local market of Allahabad.

Banana was collected from the local market of Allahabad.

Sugar- Brand name- Triveni sugar was collected from the local market of Allahabad.

Flavour- Banana flavour was collected from the local market of Allahabad.

Citric Acid- Citric Acid was collected from Food Technology Lab WSFDT, SHIATS.

Omega-3 fatty acid (DHA)- DHA was collected from Chemistry Lab WSFDT, SHIATS.

Four treatments were applied to twenty samples with each having five replicates. Dehydration was carried out in dried in preheated hot air oven at 120ºC for 4-5 hrs or till the mixture turned non-sticky and to the moisture content of 15-20%.

CHEMICAL ANALYSIS

- **Moisture-** This was estimated as per the procedure given AOAC, 1990 method.
- **Total Solids-** This was estimated by AOAC, 1990.
- **Acidity-** This was estimated by AOAC, 1990 method.
- **Fat-** This was estimated by Soxhlet Apparatus by AOAC, 1984 method.
- **Protein-** This was estimated by Kjeldhal Apparatus by AOAC 1984 method.
- **Ash-** This was estimated by Muffle Furnace as per the procedure given in Ranganna, 1986.
- **Carbohydrate-** This was estimated by {100-(Moisture+Ash+Fat+Protein)%}
- **Antioxidant**-This was estimated by diphenyl-1-picrylhydrazyl (DPPH) method.

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ORGANOLEPTIC ANALYSIS

- Colour and appearance
- Flavour and taste
- Body and texture
- Overall acceptability

MICROBIOLOGICAL ANALYSIS

- Standard plate count- This will be determined as per the procedure given in APHA Standard Methods for the Examination of Dairy Products 1992.
- Coli form count- This will be determined as per the procedure given in APHA Standard Methods for the Examination of Dairy Products 1992.
- Yeast and mould count- This will be determined as per the procedure given in ISO Standard.

TEXTURAL PROFILE ANALYSIS

- Hardness - Hardness is defined as the maximum peak force during the first compression cycle (first bite) and has often been substituted by term firmness. Within the TPA macro, this parameter was displayed as force 2. Units were kg, g or N.
- Springiness - Springiness known as elasticity and related to the height that the food recovers during the time that elapses between the end of the first bite and the start of the second bite. It was calculated as ratio of time taken to complete second compression cycle to that of time taken for completion of first cycle. It is dimensionless.
- Cohesiveness - It is defined as the ratio of the positive force area during second compression and first compression cycle. It may also be dictated as rate at which the material disintegrates under mechanical action. It has no units. It was calculated as ratio of area of second compression cycle to that of area of first compression cycle.
- Gumminess - Gumminess is defined as the multiplication of product hardness and cohesiveness. A semisolid food is characterized by high degree of cohesiveness and low degree of hardness. It was calculated as Force 2 x cohesiveness. No units are defined for this parameter.
- Chewiness– It is defined as the product of hardness x cohesiveness x springiness.
- Resilience- Resilience is a measurement of how the samples recover from deformation both in terms of speed and forces derived. There is no unit for this parameter.

STATISTICAL ANALYSIS

The data was analyzed statistically by analysis of variance at 5% level of significance.

Number of treatments	-	4
Number of replications	-	5
Total number of samples	-	20

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COST ANALYSIS

On the basis of ingredients required in investigation work cost analysis was done per/ kg of the cost of the ingredients.

RESULT AND DISCUSSION

The data collected on different aspects were tabulated and analysed statistically using analysis of variance and critical difference. The significant and non-significant differences observed have been analysed critically within and between the treatment combinations. Average data of physio-chemical, organoleptic and microbiological parameter of different treatments of apple and banana pulp fruit bar supplemented with omega-3 fatty acid.

Parameters	**Scores/ Values based on mean values of different parameters of treatment**				**C.D Values**
1. Physio-chemical Analysis (in per cent)					
	T_0	**T_1**	**T_2**	**T_3**	
Moisture	19.72	19.82	21.08	21.16	0.91
Total Solids	80.28	80.18	78.92	78.84	0.91
Acidity	1.29	1.34	1.39	1.42	0.02
Fat	0.59	0.62	0.64	0.65	0.01
Protein	1.37	1.39	1.40	1.42	0.03
Ash	0.70	0.66	0.54	0.48	0.17
Carbohydrate	77.62	77.51	76.44	76.30	0.89
Antioxidant	14.02	22.07	28.03	35.95	0.32
2.Organoleptic Score (9- point Hedonic Scale)					
Colour& Appearance	8.12	8.29	7.54	7.05	0.92
Body & Texture	7.64	8.55	7.24	7.43	0.87
Flavour& Taste	7.72	8.08	7.59	7.21	0.41
Overall acceptability	7.58	7.80	7.29	7.26	0.32
3. Microbiological Analysis					

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SPC (×10^{3}cfu/g.)	14.40	15.00	15.60	22.00	4.21
Coli form	Nil	Nil	Nil	Nil	Nil
Yeast & Mould	Nil	Nil	Nil	Nil	Nil
4. Cost Analysis					
Fruit bar (in Rs./kg)	114.8	234.2	352.7	471.7	-

5. Textural Profile Analysis

Parameters	**T_0**	**T_1**	**T_2**	**T_3**	**C.D Value**
Hardness	2353.60	2331.20	2495.40	3048.60	382.65
Springiness	0.27	0.26	0.30	0.35	0.05
Cohesiveness	0.19	0.17	0.24	0.19	0.04
Gumminess	345.20	384.60	412.40	523.40	36.11
Chewiness	248.80	307.20	239.20	247.20	41.15
Resilience	0.05	0.08	0.11	0.14	0.06

PHYSICO-CHEMICAL PARAMETERS

(a) Moisture

From the data on moisture test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean moisture percentage was recorded in the fruit bar sample of T_3 (21.16) followed by T_2 (21.08), T_1 (19.82) and T_0 (19.72).

(b) Total Solids

From the data on Total solids test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean total solid percentage was recorded in the fruit bar sample of T_0 (80.28) followed by T_1 (80.18), T_2 (78.92) and T_3 (78.84).

(c) Acidity

From the data on acidity test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean acidity percentage

was recorded in the fruit bar sample of T_3 (1.42) followed by T_2 (1.39), T_1 (1.34) and T_0 (1.29).

(d) Fat

From the data on fat test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean fat percentage was recorded in the fruit bar sample of T_3(0.65) followed by T_2 (0.64), T_1 (0.62) and T_0 (0.59).

(e) Protein

From the data on protein test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean protein percentage was recorded in the fruit bar sample of T_3 (1.42) followed by T_2 (1.40), T_1 (1.39) and T_0 (1.37).

(f) Ash

From the data on ash test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean ash percentage was recorded in the fruit bar sample of T_0(0.70) followed by T_1 (0.66), T_2 (0.54) and T_3 (0.48).

(h) Antioxidant

From the data on antioxidant test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean antioxidant percentage was recorded in the fruit bar sample of T_3 (35.95) followed by T_2 (28.03), T_1 (22.07) and T_0 (14.02).

ORGANOLEPTIC PARAMETERS

(a) Colour& appearance

From the data on colour& appearance test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean colour& appearance percentage was recorded in the fruit bar sample of T_1 (8.29) followed by T_0 (8.12), T_2 (7.54) and T_3 (7.05).

(b) Flavour& taste

From the data on flavour& taste test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean flavour& taste percentage was recorded in the fruit bar sample of T_1 (8.55) followed by T_0 (7.64), T_3 (7.43) and T_2 (7.24).

(c) Body & Texture

From the data on body & texture test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean body & texture percentage was recorded in the fruit bar sample of T_1 (8.08) followed by T_0 (7.72), T_2 (7.59) and T_3 (7.21).

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(d) Overall acceptability

From the data on overall acceptability test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the highest mean overall acceptability percentage was recorded in the fruit bar sample of T_1 (7.80) followed by T_0 (7.58), T_2 (7.29) and T_3 (7.26).

MICROBIOLOGICAL PARAMETERS

(a) Standard Plate Count

From the data on SPC test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the lowest mean SPC percentage was recorded in the fruit bar sample of T_0 (14.40) followed by T_1 (15.00), T_2 (15.60) and T_3 (22.00). There was significant difference between all the treatments which may be ascribed by the different levels of fruit bar.

(b) Coli form

It is evident from the data on Coli form test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control was 100 percent negative. It shows the absence of gram-negative bacteria which means that strict hygienic procedure was maintained during the preparation.

(c) Yeast & Mould

It is evident from the data on Yeast & Mould test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control was 100 percent negative.

TEXTURAL PROFILE ANALYSIS

(a) Hardness

From the data on hardness test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the lowest mean hardness percentage was recorded in the fruit bar sample of T_1 (2331.20) followed by T_0 (2353.60), T_2 (2495.40) and T_3 (3048.60).

(b) Springiness

From the data on springiness test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the lowest meanspringiness percentage was recorded in the fruit bar sample of T_1 (0.26) followed by T_0 (0.27), T_2 (0.30) and T_3 (0.35).

(c) Cohesiveness

From the data on cohesiveness test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the lowest mean cohesiveness

percentage was recorded in the fruit bar sample of T_1 (0.17) followed by T_0 (0.19), T_3 (0.19) and T_2 (0.24).

(d) Gumminess

From the data on gumminess test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the lowest mean gumminess percentage was recorded in the fruit bar sample of T_0(345.20) followed by T_1 (384.60), T_2 (412.40) and T_3 (523.40).

(e) Chewiness

From the data on chewiness test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the lowest mean chewiness percentage was recorded in the fruit bar sample of T_2 (239.20) followed by T_3 (247.20), T_0 (248.80) and T_1 (307.20).

(f) Resilience

From the data on resilience test in apple and banana pulp fruit bar supplemented with omega-3 fatty acid samples of different treatments and control, the lowest mean resilience percentage was recorded in the fruit bar sample of T_0(0.05) followed by T_1 (0.08), T_2 (0.11) and T_3 (0.14).

CONCLUSIONS

From the study of four treatments applied to twenty samples it may be concluded that the samples of treatment T_1 was found the best in every aspect of organoleptic analysis, i.e., colour and appearance, flavor and taste, body & texture and overall acceptability.

Samples of treatment T_1 was found best in microbial analysis, i.e., minimum SPC, no Coliform and no yeast and mould count present during research in apple and banana fruit bar supplemented with omega-3 fatty acid. It was found that the treatment T_1 was best in the physio-chemical analysis as well as antioxidant activity.

Therefore, it may be concluded that, there is a great scope of manufacturing fruit bar using apple and banana pulp supplemented with omega-3 fatty acid as it is proved to have nutritional properties as well as health benefits and it is good for all age group people.

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