DEVELOPMENT OF A LOW CALORIE, HIGH ENERGY FRUIT BAR

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ABSTRACT
Low-calorie high energy fruit bars were prepared from apple juice in combination with locally grown fruits such as grape, banana (poovan variety). The fruit extract, both in juice and pulp form was mixed in different proportions i.e 30:70, 40:60, 50:50, 60:40, and 70:30 and additives such as sugar, pectin, and sodium benzoate were added. The fruit bars were dried in a cross-flow dryer until they reached a moisture content of 12-20% as per the guidelines specified under the Food Safety & Standards Act, 2006. The prepared fruit bars were analyzed for moisture content and Vitamin C content. While the Vitamin C content of the prepared fruit bars ranged from 18-24 mg/g of the sample the moisture content of the fruit bars varied from 12-20%.

Keywords: Fruit Leather; Fruit bars; Healthy Snacks; Fruit Extracts; Value-added Fruit products.

http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=9&IType=9

1. INTRODUCTION
According to SNAC International (formerly the Snack Food Association), consumers have resorted more to snacking today even though they are more conservative in their food choices today than a few years ago. [1] Snacking by definition included any food intake occasion that cannot be categorized as a main meal, light meal/breakfast or a drink (Berteus et al; 2005). It is often recommended to negate nutrient shortfall associated with intake of three regular meals per day and is often advocated to meet the higher energy requirements due to higher physical activity [2] (Kerver et al; 2006). In today’s context, consumption of snacks is related more towards practical factors like inadequate time or access to ‘proper’ meals. However, it must be recognized that there are some genetic factors which also may be at work in some
instances. [3] There is scientific evidence linking generic factors to eating behaviors such as, the amount of food or drink consumed at a point or how hungry we are before eating (De Castro, 2002). Snacking preferences and need are more complex due to a combination of factors such as cultural, social, religious, practical, and personal influences. Studies indicate that there is a sharp increase since 2009 in the number of consumers snacking three or more times daily and that consumer’s snack even more as they progress in age. Though a majority of the consumers are trying to eat healthy foods, many view snacking as a part of their overall dietary plans. Government bodies on the other had has recommended that consumers should make a conscious effort to consume healthier, natural snacks in contrast to high-calorie, low-nutrient junk foods. Give these circumstances; the present study was aimed at developing a highly nutritious fruit bar - health snack from a variety of fruits such as apple, grape and banana that are commonly grown and available in Coimbatore, Tamil Nadu, India.

2. MATERIALS AND METHOD

2.1. Materials
Apples, Bananas, Grapes were brought from the local fruit mundi. Chemicals such as Pectin, Sodium benzoate, Pectinase, 2, 6-dichlorophenol indophenol, Meta-phosphoric acid, ascorbic acid and Phosphoric acid were all purchased from M/s. Precision Scientific Pvt. Ltd, Coimbatore and were all of analytical grade.

2.2. Methodology

2.2.1. Enzymatic extraction of Apple Juice
Apples are processed into juice annually by enzymatic juice extraction as described by Shefali S. et al. (2013). Fresh apples were purchased and thoroughly washed. The apples were peeled, cored and grated to thin slices that are roughly 1mm in thickness [4]. Equal amounts of sliced apples were placed in vessels and a solution of pectinase enzyme (Concentration 10mg/ 10ml D.W.), was added with water, enough to submerge the sliced apples in each vessel. The apple slices were stirred in the pectinase enzyme solutions to ensure uniform wetting of the apple slices. The vessels were covered with a plastic cover and placed in a hot water bath at a temperature of 45°C for 2 hours. After removing from the water bath, apple juice was filtered from the apple pulp with a muslin cloth.

2.2.2. Extraction of Grapes Juice.
Fresh grapes were purchased and thoroughly washed. Grapes were pulped in a blender and the skin and seeds were separated out from pulp by a sieve. Pulp was pressed and filtered using a muslin cloth to extract clear juice.

2.2.3. Preparation of Banana Pulp
Poovan variety bananas were purchased, peeled and pulped in a blender

2.2.4. Preparation of Fruit Bar (Apple – Grape fruit bar)
Apple-Grape fruit bar was prepared by a method described by Lemuel et al., 2014. Juices of apples and grapes were mixed in different proportions, i.e. T1= 50:50, T2= 60:40, T3= 40:60, T4= 70:30 and T5= 30:70. The juice mixture was heated upto 100°C while 20% of sugar and 1% of pectin was added to the juice mixture with continuous stirring. 0.1% of sodium benzoate was added as a preservative. When the Brix° of the total mixture reached 75°, the heating was stopped and the mixture was poured into trays covered with butter paper. The
mixture was allowed to dry at room temperature 10 hours. The fruit bars formed were stored in air tight containers.

2.2.5. Preparation of Banana – Grape fruit bar

Banana-Grape fruit bar was prepared where, the pulp of banana and the juice of grapes were mixed in different proportions, i.e. T6= 50:50, T7= 60:40, T8= 40:60, T9= 70:30 and T10= 30:70. The mixture was heated at 100°C while 20% of sugar and 1% of pectin was added to the juice mixture with continuous stirring. 0.1% of sodium benzoate was added as a preservative. When the Brix° of the total mixture reached 75°, the heating was stopped and the mixture was poured into trays covered with butter paper. The mixture was allowed to dry at room temperature 10 hours and then dried in a cross-flow dryer for 7 hours at 60°C. The fruit bars formed were stored in air tight containers.

2.3. Chemical and Nutritional Analysis

2.3.1. Determination of Moisture Content by oven drying method

As described in the Food Safety and Standards Manual of Methods of Analysis of Foods, Lab Manual 5, this method consists of measuring the weight lost by foods, due to the evaporation of water. Hot air oven was used to determine the initial moisture content of the fruit bar sample. A 5g representing the entirety of the sample was taken in a pre-weighed petri dish and subsequently dried for 3 hrs at a temperature of 105°C. The weight of the sample was measured at a regular interval of 30 mins until the differences in weight between two successive weights became approximately same. Moisture content in percentage was calculated using the following formula.

\[
\text{Moisture content (w.b. %)} = \frac{W_0 - W_f}{W_0} \times 100
\]

Where,

\[
W_0 = \text{Initial weight of sample (g)}
\]

\[
W_f = \text{Final weight of sample (g)}
\]

2.3.2. Vitamin C Estimation

Fruits and vegetables are a main source of ascorbic acid required for human diet. The most satisfactory chemical methods of estimation are based on the reduction of ascorbic acid by 2, 6-dichlorophenol indophenol indicator. This dye which is blue in alkaline solution turns red in acidic conditions and is reduced by ascorbic acid to a colourless form. The reaction is quantitative and practically specific for ascorbic acid in solutions. 10 g of the fruit bar sample was grounded and crushed with m- phosphoric acid and 2ml of the sample extract was made up to 100 ml with m- phosphoric acid. 1 ml of the sample filtrate was taken and again made up to 100 ml with m- phosphoric acid. The sample filtrate was titrated against 2, 6-dichlorophenol indophenol dye. The titer value was noted and the amount of ascorbic acid was calculated using the following formula:

\[
\text{Ascorbic acid (mg/g)} = \frac{\text{Titer value x Dye factor x Dilution} \times 100}{\text{Weight of sample x Weight of extract}}
\]

3. RESULTS AND DISCUSSIONS

3.1. Yield of the juice extracted for Apple - Grape Fruit bar

Percentage yield of juice by enzymatic extraction from Apples after peeling and coring = 73%. Percentage yield of juice extracted from Grapes = 80.28%.
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3.2. Yield of the juice extracted for Banana - Grape Fruit bar
Percentage yield of juice extracted from Grapes = 78.20%. Percentage yield of pulp from Banana, after peeling = 96.67%

3.3. Formation of Apple – Grape fruit bar
The five proportions of fruit bar were set at room temperature after 10 hours. Translucent bars were obtained, having smooth texture and which could be easily cut.

3.4. Formation of Banana - Grape fruit bar
The five proportions did not set at room temperature after 10 hours and further, did not set after drying in cross flow dryer for 7 hours. Opaque bars were obtained, which could not be easily cut. The taste and odour of the mixture were not pleasing.

3.5. Analysis of Moisture content

3.5.1. Moisture content of Apple - Grape fruit bar
According to the fssai regulations, the moisture content of a fruit bar should not be more than 20.0 %. Fig. 12. shows the percentages of moisture content, calculated for different proportions of apple-grape fruit bar. Except for the proportion of T1 (50:50), the ranges of percentage of moisture content for the other proportions are between 12-16%, which is in accordance with the fssai regulations. Gujral H. S. and Brar S. S. reported a similar range of moisture content percentages from 12-15%, for different pulp concentrations of mango leather [5].

3.5.2. Moisture content of Banana- Grape fruit bar
In Fig. 11., the calculated percentages of moisture content of banana-grape fruit bar is shown. It is observed that, except for the proportion T4 (70:30), the ranges of percentage of moisture content for the other proportions are between 14-20%. Ayotte (1980), reported a similar range of moisture content percentages of 15-20%, for blended papaya and guava fruit pulps [6], in the ratios of 80: 20, 60: 40, 40: 60, and 20: 80.

It is also observed that, the proportions having relatively higher moisture content percentages (60:40 and 70:30) did not form a stable fruit bar.

3.6. Analysis of Vitamin C

3.6.1. Vitamin C content of Apple-Grape fruit bar
Fig. 12. shows observations for the vitamin C content per gram of the sample apple-grape fruit bar. It is observed that, the proportions having more ratio of grapes juice, have more vitamin C content in comparison with the proportions having more ratio of apple juice. Although apple has a relatively more concentration than grapes, Larrauri et al., (1998) reports that, the peel of apples have more ascorbic acid content than that of grapes [7]. Removal of peel from apples for obtaining clarified juice leads to reduction in the ascorbic acid, which may be the reason for the above observations.

3.6.2. Vitamin C content of Banana-Grape fruit bar
Fig. 12. shows observations for the vitamin C content per gram of the sample banana-grape fruit bar. From the above observations, all the proportions had equal amounts of vitamin C content.
Figure 1 Fruit bar - Apple: Grape (40:60)

Figure 2 Fruit bar - Apple: Grape (60:40)

Figure 3 Fruit bar - Apple: Grape (30:70)

Figure 4 Fruit bar - Apple: Grape (70:30)

Figure 5 Fruit bar - Apple: Grape (50:50)

Figure 6 Fruit bar - Banana: Grape (40:60)

Figure 7 Fruit bar - Banana: Grape (60:40)

Figure 8 Fruit bar - Banana: Grape (30:70)
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**Figure 9** Fruit bar - Banana: Grape (70:30)

**Figure 10** Fruit bar - Banana: Grape (50:50)

**Figure 11** Percentage of Moisture content for every proportion of fruit bar

**Figure 12** Amount of Vitamin C per gram for every proportion of fruit bar
4. CONCLUSION

Fruit bars were prepared with different combination of fruits such as apple, grapes and banana. The fruit extract (both in juice and pulp form) was mixed in different proportions and additives such as sugar, pectin, and sodium benzoate were added. The fruit bars were dried until they reached a moisture content of 12-20% as per the guidelines of Food Safety & Standards Act, 2006. The following are the conclusions drawn from the analysis of the fruit bars:

a. Vitamin C content of the prepared fruit bars ranged from 18-24 mg/g of the sample.

b. Fruit bars prepared from apple-grape combination had good sensory and textural acceptability.

c. Despite favorable sensory and textural qualities in the fruit bar prepared from apple-grape due to high cost of manufacture it was decided to prepare the fruit bar from banana-grape combination which would be more cost effective.

d. The profile of banana-grape fruit bar prepared was not satisfactory due to the formation of unstable bars (not solidifying in room temperature) and unpleasing taste and aroma.

It is suggested that further optimization of the fruit bar has to be done with respect to the extraction protocol, cost effectiveness and good sensory and textural acceptability.

REFERENCES