HAVE AN 'EPIC' BAR! - DESIGNING OF A NUTRIENT OPTIMIZED BAR AND ITS SHELF STABILITY

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Abstract

Nutrient bars are supplemental bars embodying ingredients from the food groups of a well balanced diet. The present study was aimed to plan and design EPIC (i.e. Energy, Protein, Iron and Calcium optimized bar) from low cost ingredients, to study the nutrient composition, to organoleptically evaluate and to study shelf stability of the formulated bar. The recipe was carefully standardized (by varying the amounts of honey to 40, 45 and 50g) and keeping the quantities of whole wheat flour, soya flour, puffed rice and gingelly seeds constant. The bar was evaluated by panelists for sensory scores using Nine-point Hedonic method given by Amerine *et al.*, 1965. The bar prepared from 40 g of honey was liked extremely by 80% of the panelists. This bar was subsequently chosen for the purpose of study and stored at about -10 ±5ºC for 4 months after being separately hot sealed in food grade poly propylene films and vaccum packaged in metalized polyester sheets respectively. The EPIC bar was recorded to have furnished a physiological energy of 429 kcal, crude protein content of 17 per cent, iron content of 5.22mg/100g and calcium content of 198 mg/100g respectively. The Total Viable Count was estimated to be 4.0×10^3 cfu/g for hot- sealed bar and it was 3.0×10^3 cfu/g for vaccum packaged bar that clearly defined the vaccum packaged bar to be safer for human health.

Keywords: Supplemental, Poly Propylene films, Metallized Polyester sheets, Vaccum packaged, Total Viable Count.

Introduction:

India occupies the topmost position amongst the countries of the world where the prevalence of undernourished children is rampant. The primary cause of malnutrition is under nutrition in children of less than five years of age (Sahu *et al.*, 2015). Nutrient dense bars can serve as supplement the balanced diets of these children at a low cost. It can also be a supplemental food to the children enrolled in Anganwadis in India. Also it can be supplied as a low cost supplemetal diet to the military forces and severely impacted people in calamity struck places.
In the area of sports, ergogenic aids may allow an individual to undertake and tolerate heavy training in their stride by subsequently promoting faster recovery and maintain good health during arduous training.
In space, John Glenn was the first human to eat in microgravity of space. The first energy bar, the Space Food Sticks was developed by Robert Muller, the inventor of the HACCP standards. The bar that appeared in the American marketplace abridged the gap between the foods consumed by the astronauts during their space endeavors to the food consumed by people residing on Earth.

Numerous convenience supplements entail ready to drink supplements (RTD's), energy bars, and energy gels. The consumption of these supplements is beneficial both before and after an exercise event utilizing less time for its consumption during peak activity hours (Kreider *et al.*, 2010).Bars mostly harbor carbohydrates in form of sugars like fructose, glucose, maltodextrin, dextrose used in various ratios.

This is done to render it a characteristic flavour and taste. Space bars use less of fat so as to have a prolonged shelf- life. The choice of the ingredients to be selected for the formulation of the convenience supplements largely depends on the ingredients' cost, availability, nutritional composition, bioavailability of nutrients, cost of processing and packaging and shelf- life of the formulated product.

Keeping in view the advantages and myriad uses that energy and protein dense bars find in different fields the present research was meticulously planned and undertaken to plan and design nutrient EPIC (energy, protein, iron and calcium optimized) bar from low cost ingredients, to assess sensory characteristics and to study shelf- life of the bar.

Materials and methods:

The present study was carried out in the Department of Foods and Nutrition, College of Home Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.

Product Planning

The nutrient composition of the EPIC bar to be prepared from nutrient- dense ingredients was planned and thereby calculated for 100g of the bar using analyzed values for all the individual ingredients given by Gopalan *et al.* (2010). However the values of nutrient composition of full fat soya flour given by (Anonymous, 2009) were used for the purpose of the same. These calculated values were used as a basis to design the nutrient- dense bar by recipe standardization to yield one portion size of the product.

Selection and Sample Preparation

Whole wheat flour, full fat soya flour, white coloured gingelly seeds and puffed rice were purchased from local market, Pantnagar while honey was purchased from the Department of Entomology, College of Agriculture, Pantnagar.

Recipe Standardization

The recipe was carefully standardized as per the method used by Nadeem *et al.,* 2012 with slight modifications. The sample was prepared by sieving 100g of whole wheat flour and 100g of soya flour separately using a household metal sifter of 40 mesh size and thereby individually roasted on a low flame for about 20 minutes till the flours began to leave the sides of the pan giving a pleasant aroma. Similarly 100 g of puffed rice was also roasted on a low flame of the gas burner for about 6 minutes. The white-coloured gingelly seeds were ground to powder using an electric mixer for about 5 to 10 minutes. All the roasted and ground ingredients were left undisturbed to cool at room temperature for about 5 minutes.

All the ingredients (whole wheat flour, soya flour, puffed rice, gingelly seeds and honey), were scooped in a teaspoon individually and weighed on the digital balance to note the actual amounts procured. These amounts were then recorded against each ingredient measured. It was noted that one teaspoon each of all ingredients yielded 4.75 g of whole wheat flour, 3.40 g of soya flour, 3.80 g of puffed rice, 2.50 g of gingelly seeds and 2.3 g of honey respectively. All these ingredients were quadrupled in amount and mixed together in a mixing bowl and gradually 50 g of pre-measured honey was added till it agglutinated all the mixture together, leaving the sides of the bowl. This amount of honey used to bind was recorded to be 40.00 gm. The same method was employed in which the amount of other ingredients was kept constant but the amount of honey used was 45 and 50g respectively.

Freezing

The mixture of three bars with different quantities of honey used viz. 40, 45, 50 g was transferred to set in the rectangular moulds in freezer at approximately (-10±5ºC) for about 2 to 3hours.

Sensory Evaluation

All the three bars were subjected to sensory evaluation using Nine Point Hedonic Scale by fifteen semi- trained panelists as given by Amerine *et al.,* 1965. As per the sensory evaluation the bar that was liked the most by the panelists was considered to be the standardized recipe.

Storage

The recipe of standardized bar was replicated to formulate ten bars of 115 grams each**.** One lot was individually packed in poly propylene food-grade plastic containers wrapped in polypropylene films by hot sealing method whereas the other lot was vaccum packed in metallized polyester sheets and were then stored in refrigerator for a period of 4 months at a temperature of (-10± 5ºC) to prevent the entry of air and moisture inside the respective packages. The shelf stability of the EPIC bar was studied at a difference of every 30 days using total viable count method according to APHA (1984)

procedure.

Nutritional Composition

The bars were analysed for proximate composition (AOAC, 1995). The carbohydrate content was determined by subtracting the sum of the values (per 100 g) for moisture, total ash, crude fat, crude fibre and crude protein from hundred. The calorific value (Kcal per 100g) of sample was calculated by summing up the product of multiplication of per cent crude protein, crude fat and carbohydrate present in the sample by 4, 9, and 4, respectively (Mudambi *et al*, 1989). Among minerals, the ash solution was prepared by dry ashing as described by Raghuramulu et al. (2003) whereas the calcium content was determined by titrimetric method of AOAC (1970).The iron content was estimated colorimetrically by atomic absorption spectrophotometry (AAS).

Results and Discussions

Calculated value for nutrient composition of EPIC bar

It was found that 100 gm of the bar furnished 363 kcal energy, 62.00 g of carbohydrate, 14.00 g of protein,7.36 g of fat, 183 mg of calcium, 5.46 mg of iron and 1.03 g of fiber (Table 1).

Table 1: Calculated Nutrient composition of 100g of EPIC bar

Ingredients	Amount (g)	Energy (kcal)	Protein (g)	Carbohydrate (g)	Fat (g)	Calcium (mg)	Iron (mg)	Crude Fibre (g)
Whole wheat flour	17	58.00	2.00	12.00	0.28	8.16	1.00	0.32
Puffed rice	13	42.00	1.00	10.00	0.01	3.00	1.00	0.03
Bengal gram (roasted)	13	48.00	3.00	8.00	0.67	7.54	1.23	0.13
Soya flour	13	56.00	6.00	3.00	2.40	32.00	1.00	0.29
Sesame seeds	9	51.00	2.00	2.00	4.00	130.50	1.00	0.26
Honey	34	108.00	0	27.00	-	1.70	0.23	-
Total		363.00	14.00	62.00	7.36	183.00	5.46	1.03

Sensory Evaluation

Three EPIC bars were prepared using constant amounts of 20g whole wheat flour, 15g soya flour, 15g puffed rice, and10g of gingelly seeds. However the quantity of honey added was varied to 40g, 45g and 50g respectively. The sensory evaluation was done to select the bar that was liked the most by fifteen semi- trained panelists depicted in (Table 2).

Table 2: Sensory scores of EPIC bars formulated using 40, 45 and 50g of honey

Amount of Honey used (in g) for EPIC bar formulation	Liked extremely	Liked very much	Liked moderately	Liked slightly
40	80%	10%	10%	-
45	65%	25%	10%	-
50	55%	-	15%	30%

It was found that the EPIC bar that was formulated using 40g of honey was liked extremely by 80%, liked very much by 10% of the panelists. In addition the EPIC bar composed of 45g of honey was liked extremely by 65% of the panelists and liked very much by 25%. The bar containing 50g of honey was liked extremely by only 55% and liked moderately by 15% of the panelists. Thus the EPIC bar with highest sensory scores was found to be the one composed of 40 g of honey which was utilized for further analysis in the present study. The amounts of ingredients used in the standardized recipe of the EPIC bar are represented in (Table 3).

Table 3: Amounts of various ingredients used in grams

Ingredients	Amounts
Whole wheat flour	20
Soya flour	15
Puffed rice	15
Bengal gram (roasted)	15
Gingelly seeds	10
Honey	40

Determination of Nutrient Composition
The analysis of the sample for nutrition composition revealed 3.30% moisture, 17% crude protein, 11.60% crude fat, 2.28% crude fiber, 2.105 total ash, 64% carbohydrate by difference, 198 mg of calcium content , 5.22 mg of iron content and 429 kcal of physiological energy value furnished by the sample of bar (Table 4).

Table 4: Nutrient Composition of EPIC bar

Parameters	% Mean ± S.D
Proximate Composition	
Moisture	3.30 ± 0.17
Total Ash	2.10 ± 0.20
Crude Protein	17.00 ± 2.00
Crude Fat	11.60 ± 1.52
Crude Fibre	2.28 ± 0.28
Carbohydrate By Difference	64.00
Minerals (%mg/100g)	198.00 ± 4.44
Calcium	
Iron	5.22 ± 1.76

Note- Physiological energy value based on proximate composition is 429 kcal.

Changes in Total Viable Count (TVC) of EPIC bar
The total viable count of both hot-sealed and vaccum packaged bar increased for the period of 120 days. The TVC for the hot- sealed bar was higher than the vaccum packaged bar. The value for microbial load was in the range of 0 to 4 × 10^3 cfu/g. The probiotic viability of the cereal bars developed by incorporating the burgeoning probiotic strain *Lactobacillus casei* 01 encapsulated in Calcium-alginate beads to a final concentration of 109 CFU.g^{-1} of product and topped with honey. The Probiotic viability of storing bar for 14 days at 4 °C and 20 °C was found to be 7.50 ±0.55 and 6.72 ±0.27 log CFU.g^{-1}, respectively as recorded by Henriques, 2011.

The range of Aerobic Plate Count for *Bacillus cereus* found in frozen ready- to- eat bar immediately following production under good manufacturing conditions ranges from < 10^2 cfu/g or ml to a maximum of 10^4 cfu/g or ml is considered safe for consumption as recorded by Stannard,1997 . In accordance with the references the bar is found safe for consumption (Table 5).

Table 5: Changes in TVC of EPIC bar using two different packaging techniques during storage

Days	Total Count in cfu/g	
	Hot-sealed	**Vaccum –packaged**
1	0	0
30	0	0
60	1.5×10^3	0
90	3.0×10^3	3.0×10^3
120	4.0×10^3	3.0×10^3

Conclusion

The EPIC bar housed 3.30 per cent moisture, 2.10 per cent ash, 17.00 per cent crude protein, 2.28 per cent crude fibre, 11.60 per cent crude fat, 64.00 per cent carbohydrate and 429.00 kcal of energy. The calcium and iron content of bar was found to be 198.00 and 5.22 mg per 100 g respectively. Therefore, from the study undertaken for evaluating the shelf stability of the EPIC bar it can be clearly suggested that the vaccum packaged bar was cumulatively more acceptable (as per the organoleptic evaluation conducted) over the hot- sealed bar. The Total Viable Count of the vaccum packaged bar was reported to be low than the hot sealed bar indicating that the former is fit for human consumption over the latter. However the Total Viable Count of the two bars packaged by two different techniques was found to be within the acceptable ranges.

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