Mineral enriched novel energy bar developed from underutilized Chironji seeds and its shelf life evaluation

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Abstract

Energy bars have immense health potential and can be used as an alternative to meet the energy requirement; they are quick, convenient and easy go to food product compact with nutrients. Energy bars can be formulated with diverse ingredient that can add additional health benefits such as antioxidant, anti-flammantory and medicinal properties with high nutritional value. The objective of present study was to develop energy bar from underutilized Chironji seeds, and to analyze its nutritional and shelf life properties. Novel energy bar was formulated with chrionji, rolled oats, husked channa, roasted crushed peanuts, jaggery, raisin, popped rice and dates (binding agent). Proximate analysis of energy bar was determined as moisture (7.83%), ash (1.92%), protein (9.51%), fat (13.12%), carbohydrate (67.62%), total energy (430.08kcal), calcium (28mg/100gm), and potassium (22mg/100gm), sodium (26mg/100gm), iron (24mg/100gm). The shelf life analysis of energy bar was conducted on the basis of microbial testing, energy bar was kept at room temperature and cultured after 15 days and then after 30 days of formulation, total bacterial and mold colonies were estimated, thus the study concluded that the energy bar was highly nutritious and safe to consume within 15 days after production if kept at room temperature.

Keywords: *Energy bar, Chironji, Development, Nutritional Analysis, Shelf life Analysis*

1. Introduction

Consumption of healthy diet is often neglected in today's contemporary world majority of individual from various age group often consume unhealthy food that bolster satiety without providing nutrition, henceforth putting their health on line. Energy bars are

emerging food alternative to compensate the loss and meet the daily energy requirement without compensating the taste as energy bars are formulated with the blend of diverse ingredients. As nutrient energy bar has high amount of carbohydrates, protein, fats and minerals. They assured as an abundant source of nutrition with exemplary sensory attributes, nutrient energy bar provides quick nutrition to individuals on quick run, nutrient energy bar has gained significance and prominence in today's market and available under various names like granola bars, dry fruit bars, fruit bars, protein bars etc. [1]. The nutrient bars are convenient food source that require minimal preparation and has prolonged shelf life without refrigeration [2]. The main objective of present study was to develop a healthy and nutritious energy bar for individuals require quick energy and to utilize chironji seeds in order to enrich the energy bar with minerals.

Therefore in this study we have developed an energy bar mainly using chironji, dates, oats, husked channa, peanuts, raisins, and popped rice.

Chironji *(Buchanania lanzan)* belongs to Anacardiaceae family also known as char, achar originated from sub-continental part of India. It is a naturally grown, wild tree available in tropical deciduous part of India, commonly found in northern, western and central India they are extended to cities of Madhya Pradesh, Varanasi, Chhattisgarh and Jharkhand [3] Chironji seeds has enormous potential and are functional source of phenol, minerals, antioxidants and fatty acids [4]. Chrionji seeds has nutty flavor and commonly used as substitute of almonds. These kernel are highly underutilized, due to their pistachio like flavours they are used in few Indian cuisine like kher local residents also prepare "chironji ki barfi" which is popular for its nutrition value and taste [5] chironji seeds contain high amount of mineral particularly potassium, calcium, magnesium, iron and zinc followed by other trace minerals[6].

Dates *(Phoenix dactylifera)* are a member of palm family Palmae or Arcaceae [7]. Dates are rich source of nutrients such as carbohydrates, salts, minerals, dietary fiber, vitamins and amino acids that enhances human nutrition. Dates deactivate free radicle reaction making it an ideal antioxidants, it has anti-inflammatory, as well as anti-microbial effect [8]. Dates are also an ample source of minerals and vitamins such as potassium, calcium, magnesium, iron, zinc, copper, manganese, selenium and vitamins such as vitamin A, B-complexes and C [9]

Oats *(Avena sativa)* has high fiber, nutritional value and phytochemicals. The consumption of oats has increased due to its high dietary fiber content such as beta glucan as its potential health benefits it is also a rich source of functional protein, mineral

lipids and phytochemicals. Beta-glucan can decrease the risk of coronary heart disease and blood cholesterol level it is also known to have anti-cancerous effect, apart from nutritional oats also have antioxidant properties due to high amount of tocopherol present in oats, they are excellent source of phenolic compounds as well ferulic, caffeic, vanillic, p-coumaric are some of the most concentrated phenolic acid present in oats [10].

Peanuts *(Archis hypogea)* are often consumed as nut but they are legumes, of enormous potential as it is compact with nutrients that is essential for human health. The main components of peanuts are carbohydrates, protein, fats, vitamins, minerals, purines and organic acids. Consuming peanuts can attain basic energy requirement as they are abundant source of carbohydrates and lipids moreover due its high protein content they are often consume to prevent starvation [11]. Jaggery *(Saccharum officinarum L.)* belongs to the family Poaceae. Jaggery is made up of complex carbohydrates and digested slowly this feature of jaggery made it ideal for consumption as compare to sugar; jaggery is a rich source of minerals such as calcium, potassium, phosphorus, iron and other minerals. During production of jaggery in iron vessel it tends to absorb minerals from the vessel as well which makes it a good source of iron [12].

2. Material and Method

2.1 Development of energy bar

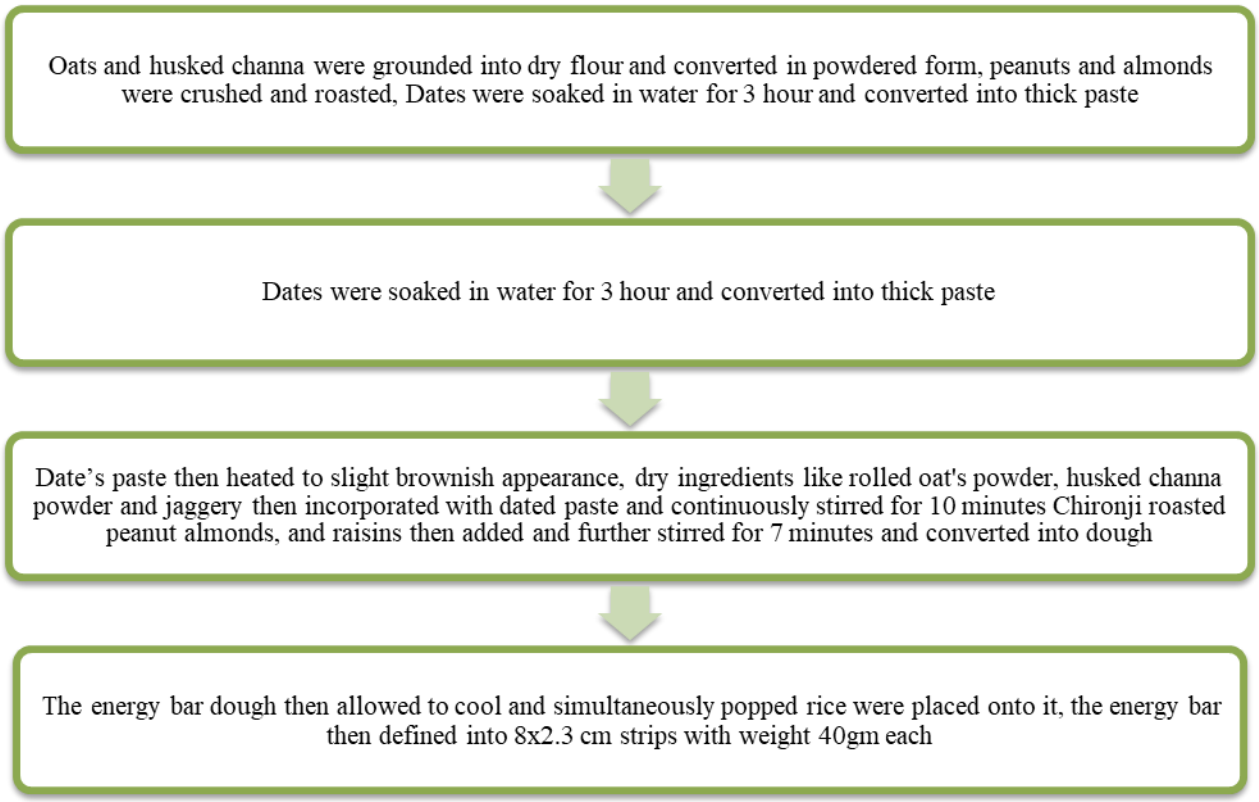
2.1.1 Raw material

Raw material for energy bar include Chironji seeds, dates, oats, husked channa (black chickpea) jaggery, peanuts, and puffed rice collected from local market of Lucknow, U.P, India.

Preparation of energy bar: Ingredients for energy bars Dates 200gm, rolled oats 100gm, chironji seeds 100gm, husked channa 50gm, crushed peanuts 50gm, jaggery 30gm, raisins 20gm, and popped rice 40 gm. Rolled oats and husked were roasted for 15 minutes which enhances flavours and evolved the taste, then they were converted into fine powder. Dates were soaked in water for 3 hours and then converted into thick paste. Dates paste further cooked at low temperature for 5 minutes. Dry ingredients likes oats and husked channa powder and jaggery were incorporated in date’s paste and continuously stirred for 10 minutes. Chironji seeds, peanuts and raisins were further blended with the paste and stirred for 7 more minutes. The mixture then removed from

the heat and placed in a mould and puffed rice was topped on the energy bar mixture, the energy bar was cut into 8x2.3 cm and end product was cooled.

2.1.2 Flow diagram of energy bar:



2.2 Nutritional analysis

The nutritional composition (moisture, ash, crude fat and crude protein) of energy bar was analyzed by AOAC, 2000[13]. The moisture content was determined by oven drying method, ash was determined by incernating, crude fat with soxhlet apparatus and protein with kjeldal method.

2.2.1. Determination of moisture content by Oven drying:

Dry and moisture free petriplate was weighed, 3gm of sample was uniformly spread in a petriplate and weighed, and the sample was then placed in hot air oven for 3h at 1050C and immediately transferred to desiccator and cooled and reweighed

Moisture% = [(Wi – Wf) / (Wi)] x 100 (AOAC 2000)

Where,

Wi = Weight of sample before drying

Wf = Weight of sample after drying

2.2.2. Ash content by muffle furnace:

5gm of sample was measured in a crucible and ignite at 5500c for 6 hours; the amount of ash in a sample was calculated as formula:

Ash% = [(Wi- Wf)/ (W0-Wf)] X 100 (AOAC 2000)

Where,

Wi = weight of sample and crucible before sample ignition

Wf = Crucible weight

W0 = weight of ash and crucible

2.2.3. Crude Fat by Soxhlet Method:

Crude fat of energy bar was analyzed by soxhlet apparatus. 5gm of moisture free sample weighed in a thimble and placed in soxhlet apparatus. Crude fat was extracted by petroleum ether as a solvent for 16 hours. The solvent was heated at 300 c throughout the period to extract the fat, after extraction the solvent was evaporated at 500c, than the beaker was re-weighed to estimate the amount of crude fat.

The crude fat was calculated as follow:

%Crude Fat = [(W1- W2)/ W0] x 100 (AOAC, 2000)

Where,

W1 = Weight of oil and flask

W2 = weight of empty flask

W0 = Weight of dry sample

2.2.4. Crude Protein by Kjeldal Method (AOAC, 2000):

Crude protein of energy bar was analyzed by kjeldal method. 1 gm of sample, was weighed and added to digestion flask with 200ml conc, H2SO4 and 5 grams of Kjeldal catalyst, the flask was heated for 2 hours until a clear black solution appears and the digestion was attained, 60ml of distilled water was added to the sample and transferred to the condenser, and submerged in standard acid the flask was heated until the NH3 distillated. The sample then titrated with standard NaOH solution. The Nitrogen content was further multiplied with 6.25 to estimate the crude protein content.

2.2.5 Carbohydrate determination:

The carbohydrates was determined by difference method Carbohydrate = 100-(moisture+ ash+ crude protein+ crude fat) expressed in grams per 100 grams of dry matter (g/100g of dry matter) (BeMiller and Low, 1998) [14].

2.2.6 Total Calorie determination:

The calorie content of energy bar was determined by calculation. Total crude protein and carbohydrates were multiplied by factor value 4 (the energy obtained from each gram of carbohydrate and protein is 4kcal). The crude fat content was multiplied by 9 (the energy obtained from each gram of fat is 9kcal), the sum total was further added to estimate the total calories. Energy= (crude protein x 4) + (crude fat x 9) + (carbohydrate x 4) Nielsen method [15].

2.2.7 Mineral estimation:

The ingredient employ in the preparation of energy bar such as chironji, oats, dates, husked channa etc. are reserve source of minerals so, the estimation of total calcium, potassium, sodium and iron was carried out using atomic adsorption spectrometry (AAS) [AOAC 2000].

2.3 Shelf life analysis

Food products are susceptible to microbial spoilage as it provides favorable condition for the growth of microbes, which contributes in the deterioration of the product so, it became essential to analyze that newly developed product, is microbially safe for consumption [16]. For the shelf life analysis of the energy bar the sample were subjected to microbial testing, which includes total plate count for bacteria and mold. The energy bar at room temperature was analyzed twice within 15 days of interval. Media used for bacterial analysis was plate count agar (PCA) and for mold was potato dextrose agar (PDA) [17]. The secondary culture was further gram strained for analysis of different microbes present in energy bar.

3. RESULT AND DISCUSSION

3.1 Nutrient content of energy bar

The nutrient content of energy bar is illustrated in table 1. The moisture content of energy bar was estimated 7.83g/100g, total energy content of the bar was found as 430kcal/100g which makes it a rich source of energy, the total carbohydrate content was 67.62g/100g, total fat was 13.12g/100g, and total protein was 9.51g/100g. The above result demonstrated high nutritional content of the energy bar. The ash content was 1.92g/100g, which indicates high mineral content in the energy bar. The estimated mineral content of energy includes calcium content 28mg/100g, potassium content was 22mg/100g, sodium and iron content was 26mg/100g, 24mg/100g respectively, Mineral content of the energy bar is illustrated in table 2.

Table 1: Nutritional composition of energy bar

S.No.	Nutritional Composition	Value per (100g)
1.	Total energy	426.6 (kcal)
2.	Total carbohydrates	67.62
3.	Total fat	13.12
4.	Protein	9.51
5.	Moisture	7.83
6.	Ash	1.92

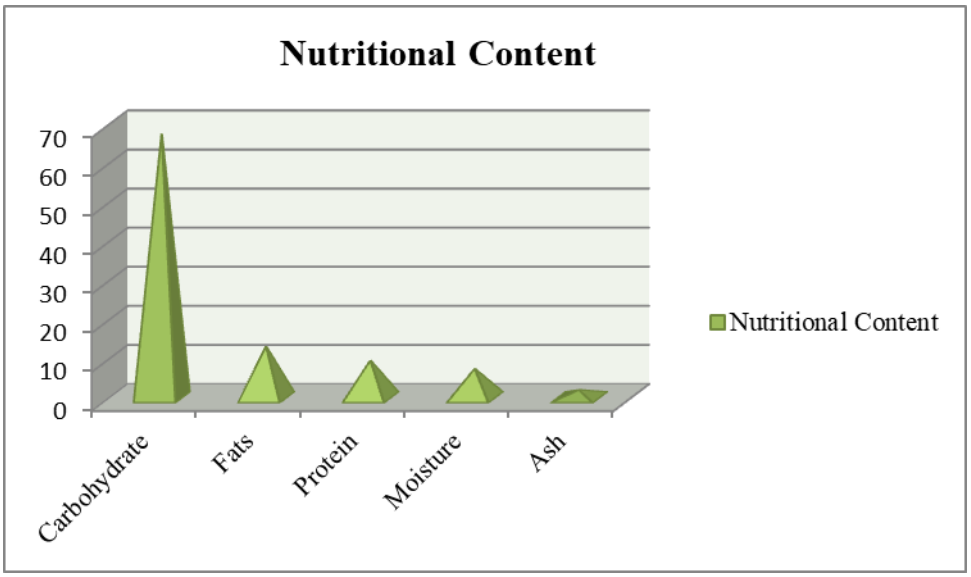


Figure 1: Graphical representation of, total carbohydrates, total fat, protein, Moisture and ash

Table 2: Calcium, potassium, iron and sodium

S.No.	Mineral composition	Value (per100g)
1.	Calcium	28 (mg)
2.	Potassium	22 (mg)
3.	Sodium	26 (mg)
4.	Iron	24 (mg)

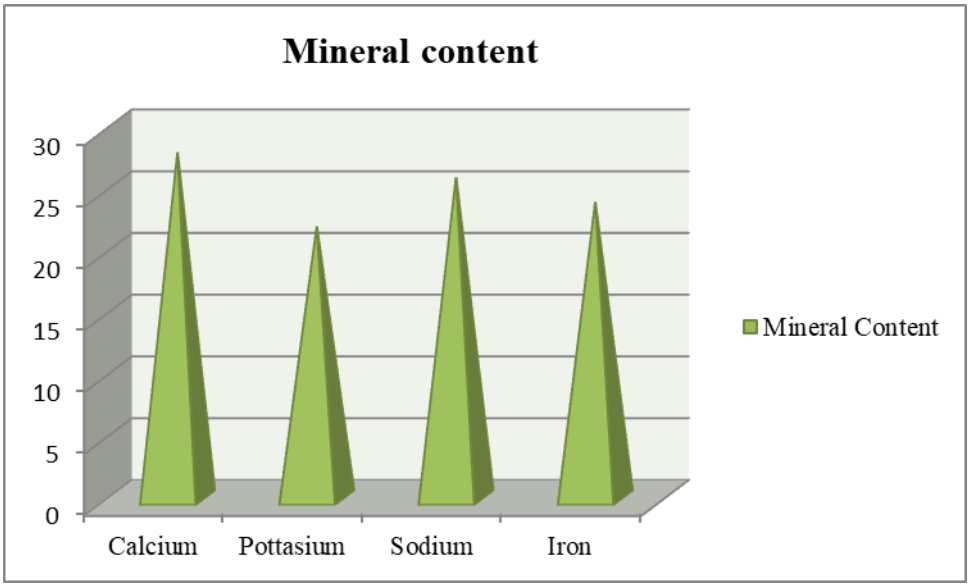


Figure 2: Graphical representation on calcium, potassium, sodium and iron

3.2 Microbial Shelf Life analyses of energy bar

Energy bar was kept at room temperature for 15 days. Shelf life analysis was conducted twice within 15 days of interval. The total aerobic plate count (cfu/g) for bacteria was calculated $1.7x10^2$, which increased after 30 days to $2.4x10^3$. The common bacteria observed include gram positive bacilli and streptococcus. The mold count (cfu/g) observed as $1.5x10^2$, which increased up to $2.5x10^3$.

The estimated result concluded that the energy can be consumed within 15 days after the day of manufacturing.

Table 3: Microbial Analysis of Energy Bar

No. of days	Bacterial load cfu/g	Fungal load cfu/g
15 days	1.7×10^2	1.5×10^2
30 days	2.4×10^3	2.5×10^3

4. Conclusion

The objectives of the present study was to develop a healthy energy bar utilizing chironji seeds that meet the daily energy requirement of the individuals as well as to utilize the chironji seeds as they are highly underutilized and are only consumed in few Indian dishes. The bar was formulated with diverse ingredient for nutritional benefits. From

outcome of the result we can conclude that the novel energy bar was highly nutritious and healthy and can be consumed by the individuals of diverse age group. The energy bar was also an enormous source of minerals. The result of the microbial analysis for shelf life estimation indicates that the energy bar can be consumed before 15 days of manufacturing, if kept at room temperature, from the above study it can be concluded that the chironji seeds with other ingredients such as rolled oats, husked channa, dates, jaggery, peanuts, raisins and puffed rice can be utilized for energy bar as each ingredient has a significant health. Thus the present study concluded that highly nutritious energy bar with high nutrition and mineral content including good texture, taste, appearance and aroma can be prepared from underutilized chironji seeds and it offer wide range of additional benefits beyond regular food product.

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