

Mineral Content Analysis of Polyherbal Energy Bar Using X-Ray Fluorescence Technique

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ABSTRACT

Aim: The objective of the present study was to develop a novel energy bar which is nutritious and cost effective. **Materials and Methods:** The components used for the novel energy bar were banana, orange, peanuts, raisins, cocoa butter, stevia leaves and oats. Mineral contents of energy bar were analysed by XRF technique. **Results:** The mineral contents were present in comparable amount. Major elements viz. K 17.15%, P 4.57%, Mg 1.43%, Ca 0.93%, Na 0.66%, S 0.54%, Fe 0.15%, Zn 0.05% and Cu 0.02% were present in energy bar. **Conclusion:** Minerals are good for overall growth of body. The energy bar also contains no preservatives, binding agents and sugar free. So, the energy bar is major source of energy and minerals for all age group individuals.

Key words: Energy bar, Mineral content, Polyherbal, Calcium, Iron, Potassium.

INTRODUCTION

Consumers demand and desire the health foods, which are portable, convenient and proportioned as well. Often, many options aren't available that are minimally processed, rich in nutrients and tastes good.¹ The food bars are snacks of good sensory and nutritional characteristics due to their high carbohydrates, proteins, lipids and minerals contents.² One of the major challenges is to provide consumers with healthy ready to eat foods. Often, many options aren't available that are minimally processed, rich in nutrients and tastes good. Energy bars, a food product that fits these criteria, continue to increase in sales according to the AC Nielsen Market Track.³ The energy bar consists of banana, peanuts, raisins, oats, orange juice, stevia leaves, cocoa butter and chocolate. Banana scientifically known as *Musa paradisiaca* belonging to family *Musaceae*. It is major source of proteins and energy. It has also powerful antioxidant and antidabetic potential.⁴ Peanuts are a favourite food, whether eaten alone as a snack food or mixed into candy and cookies etc. Peanuts are good sources of monounsaturated fats, vitamin E, niacin and B₆.^{5,6} Oats are rich source of dietary fibers, beta glucans and dietary fibres which are helps in reduction of glucose level in diabetic patients and also acts as hypolepidemic agent.^{7,8}

The dark chocolate is great source of energy and it is an anti-oxidant, good for the heart, also as memory enhancer used.⁹ Cocoa butter contains saturated fat and low amounts of caffeine and theobromine. It also contains lipids dissolving antioxidants such as α and β , γ -tocopherol which helps in its storage by increasing

its therapeutic properties.¹⁰ Minerals are very good source of energy for overall health. They generally help in maintenance of muscles functioning, acid base balance and nerve stimulations.¹¹

The objective of the present study was to prepare a healthy and nutritional energy bar by using different natural ingredients. Also, to check the mineral contents present in the energy bar using X-Ray Fluorescence (XRF) method.

X-ray Fluorescence

XRF is the emission of x-rays from a material that has been excited by bombarding with high energy x-rays or gamma rays. This technology provides one of the simplest, most accurate and most cost-effective analytical methods for the investigation of the chemical composition of many types of materials, particularly in the determination of metals, building materials, glass and ceramics and also for research in geochemistry and forensic science. It is non-destructive and reliable, requires no, or very little, sample preparation and is suitable for solid, liquid and powdered samples.¹² It can be used for wide range of elements and provide detection limits at the sub-ppm level.¹³

MATERIALS AND METHODS

Raw Materials

Raw materials like ripe banana, oranges, raisins, oats, cocoa butter, dried stevia leaves, dark

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compound chocolate for final coating were purchased from the local market.

Method of Preparation

1. Ripe banana pureed in a mixer grinder added with the juice of two oranges approximately. Roasted peanuts which have their skin removed are ground in a mixer to a powdered form all these are mixed with cocoa butter and powdered stevia leaves.
2. All ingredients are cooked together on low heat until the juice evaporates and becomes a homogeneous paste on low simmered heat for 15 min approximately for a batch of approximately 400gm puree of ripe banana.
3. On cooling the mixture we added the oats and raisins and refrigerated the mixture for half an hour, so that we may hands mold them into shape or bars.
4. This is later dipped in tempered dark chocolate of 31°C to form the outer coating and thereby completing the bar.

Tempering of chocolate

1. First pieces of chocolate are broken put in a heavy bottom pan in a double boiler and allowed to melt.
2. The temperature of chocolate has to be regulated by a thermometer and brought up to approximately 42 to 45°C.
3. This process is repeated at least two times, with alternation of cooling and heating, the chocolate is cooled till 30°C. This temperature change is done to bring out a shine and texture to the chocolate and repeated till the desired sheen is acquired. The chocolate being melted at controlled temperatures is what tempering is all about.

Mineral Content Determination

Sample preparation

The 100gm of energy bar sample was weighed using weighing machine. The quantity was poured into crucibles then it was placed in the muffle furnace for combustion to a temperature of 500–600°C. The ash obtained after combustion allowed cooling in the muffle furnace for 24 – 30 h to room temperature and with the use of forceps and spatula the content of the crucibles for each sample was transferred into a pan for a Re-weighed.

Method of XRF Analysis

The method of XRF analysis involves keeping the geometry of the tube-sample-detector assembly constant; the sample was prepared as a flat disc, typically of diameter 28mm and thickness 1mm. Samples were located at a standardized, small distance from the tube window. Because the X-ray intensity follows an inverse-square law, the tolerance for this placement and for the flatness of the surface must be very tight in order to maintain a repeatable X-ray flux. Ashes were machined to shape and finely ground and pressed into a tablet. A further reason for obtaining a flat and representative sample surface was that the secondary X-rays from lighter elements often only emit from the top few micrometers of the sample.^{14,15}

RESULTS AND DISCUSSION

White milky ash was obtained after combustion of energy bar in furnace. The various elements were detected by XRF method. The major elements which were detected sodium, potassium, calcium, iron, phosphorus and magnesium etc.

Potassium (K) is also a vital mineral for maintaining fluid and electrolyte balance in the body. Potassium in association with sodium ions, potassium plays an important role in the nerve functions and also for muscle

Table 1: Mineral composition of Polyherbal energy bar.

Sr. No.	Elements	Intensity	Percentage
1	K	424.4 KCps	17.15 %
2	P	100.9 KCps	4.57 %
3	Na	3.2 KCps	0.66 %
4	Mg	20.1 KCps	1.43 %
5	Fe	15.3 KCps	0.15 %
6	Cu	4.0 KCps	0.02 %
7	Mn	3.2 KCps	0.05 %
8	Ca	16.3 KCps	0.93 %
9	Zn	14.3 KCps	0.05 %
10	S	18.9 KCps	0.54 %

Kilocounts per second (KCps)

growth. K 17.15% was present in novel polyherbal energy bar as shown in Table 1. Magnesium (Mg) is an essential mineral for the human body and it helps in strengthen immune system and maintain normal nerves and muscles function. Magnesium also helps in reduction of blood pressure and blood glucose level.¹⁶

Mg 1.43% was present in novel polyherbal energy bar as shown in Table 1. Calcium (Ca) is a mineral that is mainly associated with strengthen of bones, teeth and gums. Ca plays an important role in the normal functioning of the mechanism of blood coagulation, for normal muscle functioning. Ca 0.93% was present in novel polyherbal energy bar as shown in Table 1. Phosphorous (P) helps to synthesize protein for the growth, maintenance and repair of cells and tissues. P 4.15% was present in novel polyherbal energy bar as shown in Table 1. Zinc (Zn) is an essential mineral for normal growth and development during pregnancy, childhood, adolescence and proteins synthesis in body. The insufficiency of zinc may lead to diarrhoea, stunted growth, impotence, hair loss and skin diseases and weak immunity. Zn 0.05% was present in novel polyherbal energy bar as shown in Table 1. Iron (Fe) is an essential metal ion that is involved in oxygen transport and helps regulate cell growth and differentiation. It is known that the deficiency of iron leads to anaemia which is prevalent in many parts of the world.¹⁷ Fe 0.15% was present in novel polyherbal energy bar as shown in Table 1. Copper (Cu) plays a role in proteins synthesis in our body such as collagen and hemoglobin, which transport oxygen.¹⁸ Cu 0.02% was present in novel polyherbal energy bar as shown in Table 1.

CONCLUSION

On the basis of results obtained it could be concluded that newly developed energy bar was recorded remarkable number of mineral contents. Minerals are very essential for overall mental and physical growth. Novel energy bar is good source of mineral content and thus individual feeding this energy bar will not be mineral deficient. It is beneficial for diabetic patients because there were stevia leaves used as a natural sweetener and no chemical preservatives added. The product is also gluten free so it is safe for celiac patients. This energy bar is very cost effective and it could be used as a substitute for expensive commercial formula.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

XRF: X-Ray Fluorescence; K: Potassium; Ca: Calcium; Mg: Magnesium; P: Phosphorus; Fe: Iron; Cu: Copper; KCps: Kilocounts per second.

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GRAPHICAL ABSTRACT

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Kilocounts per second (KCps)

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Ms. Rajnit Kohli: Principal, IHM, Bathinda, Punjab, affiliated to NCHMCT under ministry of tourism. She had 27 years of experience in the hospitality Sector and her expertise in food and beverages formulation and development.

SUMMARY

- The present study provides evidence that polyherbal energy bar contains various types of minerals and proteins which are helpful in growth of body. This energy bar contains all natural ingredients and no added synthetic chemical preservative and binder in formulation.



Dr. Inderjeet Singh Sandhu obtained his Ph.D. Degree in Solid State Physics from Kurukshetra University, Kurukshetra by doing research work on "Study of Diffusion in Solids & Intermetallic Compounds" He did his M.Sc. in Physics (specialization in Electronics) from Kurukshetra University, Kurukshetra. He is having 20 years experience in Teaching, Research and Academic Administration. He has guided 04 Ph.D. thesis and is guiding 04 Ph.D. students at present. His research areas include Nanomaterials, Nanoelectronics, and Nanoelectrodynamics. He has published several papers in high impact factor journals, attended and presented papers in national and international conferences. He has published several book chapters/research articles in international publications, like: Springer, CRC Press, Taylor & Francis Group. For further research details follow his research gate link: https://www.researchgate.net/profile/Inderjeet_Sandhu



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