

Nutritional and Microbiological Assessment of Nutrient Enriched Millet Bar for Adolescent Female Athletes.

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Abstract

Cereal bars are well accepted, innovative, practical and convenient food which would be an ideal food format to deliver all required nutrient in appropriate proportion for female athletes. High-carbohydrate and nutrient dense bars make great choices for fueling both before and during a long workout. As food is the excellent medium for the growth of the organism which causes food borne disease, all newly developed products should be microbiologically safe as microbial contamination can come from different sources like processing, handling packaging etc. so Microbiological and aseptic testing play a potential role in assurance of standard quality and food safety. The present study was intended to formulate millet bar and to evaluate the nutritional composition and to investigate and identify the presence of three food borne disease causing pathogen like *Salmonella*, *E coli* and *Staphylococcus Aureus* in the formulated bar. So millet based bar was formulated with millet flakes (Fox tail, Barnyard millet flakes), ragi flakes, nuts, flax seed, chia seeds, dry fruits, drumstick leaf powder, cucumber seeds, pumpkin seeds and palm jaggery without adding any artificial flavor and preservatives after standardization and different trails. The results of nutritional analysis per 100 gm of sample revealed that the millet bar contained 404 kcal energy, 56.3g of carbohydrate, 8.72g of fiber, 11.1g of protein, 14.9g fat, 160 mg calcium and 6.63 mg iron. The Vitamin A and Vitamin E content on analysis were found to be 63.5 IU and 26.8 IU per 100gm respectively. The samples were cultured and analyzed as per the Indian Standard for identification of *Escherichia coli*, *Staphylococcus Aureus* (IS 5887: 1976) and *Salmonella* bacteria (IS 5887:1996). Freshly prepared millet bar was evaluated for microbial load before packaging and storing. The result indicated that the bar had nil *Salmonella* organism and very minimal *E.Coli* (< 10 CFU/g) and *Staphylococcus Aureus* (< 10 CFU/g). The study concludes that the newly developed millet bar is nutritionally well balanced and microbiologically safe to consume.

Keywords:

Millets;
Preservatives;
Food borne disease;
Microbial analysis;
Standardization.

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1. INTRODUCTION:

Convenient ready to eat nutritious foods like cereal bars has become very popular globally and there is ever growing demand. The new trends for consumption of healthy, innovative and practical food have led to the growth of nutrition-bar market in recent years [1, 2].

India is the biggest producer of millets in the world and they are a staple food with superior nutritional qualities compared to other cereals [3]. Millets is the one of the most underutilized and neglected

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food despite their nutritive value, therapeutic use and economic benefits [4]. Adequate nutrition is important for the proper growth and development of young people. It is even more essential to the competitive youth athlete, with the higher demands due to strenuous training and competition [5].

Proper diet is crucial not only to insure optimal performance, but also to prevent “female athlete triad” which includes restrained eating, menstrual dysfunction, and poor bone health. Young adolescent athlete in particular has special needs and requirements in regard to nutrition, which must be carefully monitored [6]. So complete or partial replacement of cereals with nutritionally superior millets and other functional foods can deliver all required nutrients like carbohydrate, protein, antioxidants, fiber, vitamins and micronutrient like iron and calcium for female adolescent athletes [7].

Failure to consume appropriate diet during competition due to false belief and lack of knowledge may hamper performance [8]. Recently the demand for nutritionally superior sports foods which is low cost with good shelf life and convenient to carry are increasing among sports people.

Cereal bars are concentrated carbohydrate source which boost sugar level and helps in glycogen refueling. So millet bars can be used as pre and post competitive meal which is rich in carbohydrate, fiber, lipids and proteins to ensure slow digestion and to maximize the muscle and glycogen stores [9].

However sports involved female adolescents may benefit from interventions focused on how to healthfully increase nutrient intake particularly calcium and iron. Within this context, the aim of this study is to formulate well acceptable, nutrient dense millet based (Ready to eat) nutrition bar without artificial flavor, color and preservative for adolescent female athletes. This multipurpose bar can be used as a healthy option for pre and post competition meal.

The aim and objective of the study are

1. To formulate well acceptable millet based nutrition bar.
2. To conduct microbial analysis of the developed bar for the presence of food borne pathogens like *E.coli*, *Salmonella* and *Staphylococcus Aureus*.
3. To analysis the nutrient content of the formulated nutrition bar like Energy, Carbohydrate Protein, Fat, Fiber, Calcium, Iron, Vitamin A and Vitamin E.

2. MATERIALS AND METHODS:

2.1 Raw ingredients for preparation of millet bar:

The ingredients such as Fox tail, Barnyard millet flakes, oats, ragi flakes, puffed rice were selected in the ratio 30:30:15:15:10. Nuts like peanuts, almonds, walnuts and seeds like pumpkin seeds, sunflower seeds, cucumber seeds, flax seeds, chia seeds and nutrient dense dry fruits like dates, figs, and raisins are procured from a departmental store in Chennai. Palm jaggery syrup along with honey and butter is used as binding agent. To improve the nutritive value of the bar, dry drumstick leaves and amaranth leaves powder was added in acceptable range. Natural flavors like cardamom and cocco powder is used as flavoring agents.

2.2 Standardization of the millet bar:

Standardization can be defined as process of developing and implementing recipes using technical standards. A standardized recipe is one that has been tried, adapted and retried several times for use by a given food service operation and has been found to produce the same food to produce good results and yield every time when the exact procedures are used with the same quality and quantity of ingredients [10]. The standardization of milled bar was carried out using standard measures of ingredients in the Foods Laboratory of Clinical Nutrition and Dietetics Department, SDNB Vaishnav college of women Chromepet , Chennai.

2.3 Preparation of millet bar:

1. All dry ingredients like flakes, seeds and nuts are roasted gently.
2. Dry fruits like dates, figs, and raisins are mixed in blender into fine paste.
3. Syrup was made with palm sugar, honey and mixed with butter and which is then added to the dry ingredients and dry fruits paste.
4. The mixture is then thoroughly mixed in the bowl.
5. Baking sheet is spread over the baking tray, and the mixture is added to the tray

6. The oven was preheated for 20 minutes and the mixture is baked at 180 C for 15 minutes and allowed to cool in room temperature.
7. Then cut into rectangular bar weighing 60 gm each per portion.

2.4 Study Design and Sampling method:

The study design used for the present study is an experimental study design and the sampling technique involved is purposive sampling. It is a non probability sampling and the choice of sample items depends exclusively on the judgment of the investigator. The study includes 20 female adolescent athletes from SDNB VAISHNAV COLLEGE FOR WOMEN.

2.4.1. Criteria for selection of participants:

1. Willingness of the subjects to participate in the study.
2. Subjects belonging to the age group 17 – 19 years were selected.
3. Participants who spends atleast 2 hours per day on competitive physical activity.

2.5 Acceptability test:

Acceptability test was conducted for the prepared bars in by evaluating the different sensory attributes like appearance color, flavor, texture, taste and overall acceptability by 20 sports girls after seeking prior permission using self developed score card.

2.6 Nutrient analysis of the Composite Sports bar:

Energy needs of adolescent's sports girls are influenced by activity level, basal metabolic rate, and vary substantially from sport to sport. Carbohydrate is essential nutrient for continuous supply of energy and to maximize the muscle and liver glycogen stores. Pre or post event meal should be digested slowly i.e rich in protein, fiber and fat and should be consumed three hours prior to the competition to ensure steady supply of carbohydrates. Good quality protein is essential to maintain the muscle mass. Adequate iron is a key mineral for better endurance for adolescent sports girls. Iron rich food should be included in the diet to prevent iron deficiency anemia. Increased calcium loss in sweat and urine during high intensity exercise has been reported by baker et al in 2011 [11]. So calcium is very important to maintain bone health. Role of antioxidants in counteracting free radical damage is well documented [12]. These evidence based research motivated the researcher to formulate nutrient rich millet bar. The proximate nutrient composition such as energy, carbohydrate, fiber, fat, protein, calcium and iron content were analyzed using standard procedure by AOAC (2016). Vitamin A and vitamin E was also determined.

2.7 Microbial analysis of food borne pathogens:

As food is the excellent medium for the growth of the organism which causes food borne disease which is considered as global burden by WHO. Food borne diseases are largely preventable, though there are no simple one-step measures. All newly developed products should be microbiologically safe as microbial contamination can come from different sources like processing, handling packaging etc. so Microbiological and aseptic testing play a potential role in assurance of standard quality and food safety. The present study focus to investigate and identify the presence of three pathogens like *Salmonella*, *E coli* and *Staphylococcus Aureus* in the formulated bar to prevent food borne disease.

3. RESULTS AND DISCUSSION:

The main findings of this study indicates that overall acceptability of newly formulated millet bar in terms of sensory parameters like taste, appearance, flavor, texture, and color were found to be good and acceptable.

3.1 Nutrient analysis of the millet bar.

Table 1: Nutrient analysis of the millet bar

S.No	Nutrient	Method	Nutritive value for 100 gm	Nutritive value per 60 gm
1	Energy	FAO Method	404 k cal	242 Kcals
2	carbohydrate	CTL/SOP/FOOD/262 – 2014	56.3g/100g	33.78 g
3	Protein	AOAC 20 th Edn.2016, 986.25	11.1 g/100g	6.66 g
4	Fat	AOAC 20 th Edn.2016, 954.02	14.9 g/100g	8.94g

5	Dietary fiber	AOAC 20 th Edn.2016, 985.02	8.72g/100g	5.23g
6	Calcium	IS 5949:1990 (RA.2003)	160mg/100g	96mg
7	Iron	AOAC 20 th Edn 2016, 999.11	6.63mg/100g	3.978mg
8	Vitamin A	CTL/SOP/FOOD/185 – 2014	63.5 IU/100g	38.1 IU
9	Vitamin E	CTL/SOP/FOOD/185 – 2014	26.8 IU/100g	16.08IU

The results depicted in table 1 revealed that 100 gm of millet bar provided 404 Kcals. The results concluded that the millet bar is energy dense as energy dense food should be provided to prevent negative energy balance. The formulated bar provides 56.3g carbohydrate, 11.1 g protein, 14.9 g fat, 8.72 g fiber, 160 mg calcium and 6.63 mg iron. The Vitamin A and Vitamin E content on analysis were found to be 63.5 IU and 26.8 IU per 100gm respectively. So it can be concluded that the millet bar is rich in micronutrient like iron, calcium and Vitamin A and E.

3.2 Microbiological Investigation of Millet Bar:

Table 2: Microbial Analysis of Millet Bar

S.No	Food Borne Pathogens	Results	Method
1	<i>Salmonella</i>	ABSENT / PER 25 KG	IS 5887 (Part 3):1996
2	<i>E.Coli</i>	<10 CFU/g	IS 5887(Part 1):1976 (RA.2005)
3	<i>Staphylococcus Aureus</i>	<10 CFU/g	IS 5887(Part 1): 1976 (RA.2005)

Table 2 indicates the results of microbial analysis of the developed millet bar. Microbial analysis is a very effective way to prevent food borne disease and ensure food safety. The samples were cultured and analyzed as per the Indian Standard for identification of *Escherichia coli*, *Staphylococcus Aureus* (IS 5887: 1976) and *Salmonella bacteria* (IS 5887:1996). Freshly prepared millet bar was evaluated for microbial load before packaging and storing. The result indicated that the bar had nil *Salmonella* organism and very minimal *E.Coli* (< 10 CFU/g) and *Staphylococcus Aureus* (< 10 CFU/g). So pathogenic load of millet bar was found to be below detectable limits as per standard Guideline limits and the newly developed millet bar was microbiologically safe to consume.

4. CONCLUSION:

Female adolescent athletes are special population with unique nutritional requirements. Training without proper nutritional support may end up in nutritional imbalances and deficiencies. The formulated millet bar was well acceptable and nutrient dense with high energy, carbohydrate, fiber, calcium, iron and vitamin A and vitamin E. Microbial load of the formulated millet bar was safe to consume. The study concludes that regular consumption of millet bar as pre or post event snack will have positive impact on their general health status. Based on the results and observations it can be interpreted that millet bar can go a long way in supplying required quantities of balanced nutrition for female adolescent sports girls.

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