PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 12 (12): 1061-1065, 2013
ISSN 1680-5194

Preparation and Nutritional Evaluation of Date Based Fiber Enriched Fruit Bars

B. Shaheen, M. Nadeem, T. Kauser, G. Mueen-ud-Din and S. Mahmood
Institute of Food Science and Nutrition, University of Sargodha, Sargodha, Pakistan

Abstract: Fruit bars are the products which are manufactured with cereal grains and the other ingredients such as whole-grain cereals, flaked grains, fruit and legumes. In the present study nutritious fruit bars were prepared using date paste, cereal grains like, wheat, rice, flakes of corn, oat and barley, roasted grams, peanuts, almonds, pistachio nut, coconut powder and skim milk powder. Fruit bars were evaluated for their physico-chemical, microbial and sensory properties. Results showed that fruit bars containing dry mix fruits showed maximum protein (13.63%) and ash (3.93%) content while the maximum fiber content (8.07%) was found in fruit bars containing coconut powder. The maximum gross energy (386.96Kcal) was given by peanut based fruit bar. The microbial analysis of all the bars showed results within acceptable limits due to low water activity and high sugar content which posed no threats for microbiological growth. The study verified that date and dried fruits can be used to prepare date based fiber enriched fruit bars of good sensory and nutritional value which provide substantial amount of carbohydrates, proteins, fats, dietary fiber and minerals.

Key words: Nutrition, dates, fruit bars, dry fruits, fiber, protein, sensory evaluation

INTRODUCTION

Functional food is a natural or processed food that have known biologically-active compounds which when in distinct quantitative and qualitative amounts provides a clinically proven and documented health benefit, and thus a significant source in the prevention, management and treatment of chronic diseases of the modern age (Martirosyan, 2011). These nutritional bars are mostly made by using a base of grains, such as rice or oats, or proteins, such as legumes. The bars maybe fortified using a wide range of vitamins, minerals, herbs and other nutrients or energy rich ingredients (Gonzales and Draganchuk, 2003). Fruit bars introduced due to the need of having a product for nutritional quality and ease of access, in order to meet snack requirements between meals or for energy (Ryland *et al*., 2010).

Cereal bars are the products which are manufactured with cereal grains and the other ingredients such as whole-grain cereals, flaked grains, fruit, legumes, dehydrated or crystallized fruit, nuts, chestnuts, almonds, candies, chocolates, sugar etc. These ingredients are mixed to develop specific characteristics like color, flavor, texture and other physical properties. These can also be fortified with vitamins, minerals, herbs and other energy rich ingredients. They gain the customer attention due to their nutritional quality and ease of availability to meet the energy requirements between meals (Gonzales and Draganchuk, 2003).

Fruit bars are versatile products that appeal to all types of consumers, because they can be consumed with milk, ice cream, yoghurt, or by themselves. By incorporating cereals in fruit bars nutritious products can be formed according to consumer requirements (Maurer *et al*., 2005). Fruit cereal bars are rich in energy, dietary fiber, antioxidants, vitamins and minerals (Anderson *et al*., 2000). Dates are mostly in the form of fructose and glucose and are easily absorbed by the body (Myhara*et al*., 1999) fiber content 6.4-11.5% (Al-Shahib and Marshall, 2002) fiber is very important for the functioning of digestive system. Nuts are rich source of arginine, fiber, phytosterols, ellagic acid, phenolic compounds, flavonoids, luteolin and tocotrienols, which have cardio protective effects (Kitts, 1994).Coconut powder contain calcium, iron, magnesium, phosphorus, potassium, sodium and zinc and also vitamin C, vitamin B (Riboflavin, niacin, thiamine, folat), vitamin A, vitamin D, vitamin E and vitamin K (USDA, 2012).

Dates are very healthful and nutritious fruit which are rich in carbohydrates (70-80%) and the array of other nutrients. Carbohydrates in dates are mostly in the form of fructose and glucose and are easily absorbed by the body (Myhara *et al*., 1999). Dates are also rich in dietary fiber and that is the reason these are used to prepare high fiber foods. Due to advancement in technology, industries are capable to produce variety of products like date paste, date honey, date vinegar, date-dip, date jam etc. Dates are destined, steamed, macerated to make the paste with 20-23% moisture contents and water activity below 0.6 (Ahmed *et al*., 2005).

Fruit based cereal bars are more popular among young consumers. According to the recent survey, it is estimated that adults of 15 to 24 years old are 62.5% consumers of cereal bars. Due to the change in habits, ingestion of fiber is very low which causes the nutritional problems. Researchers have appreciated high ingestion of fiber for intestinal cure of children and adults (Santos

Corresponding Author: G. Mueen-ud-Din, Institute of Food Science and Nutrition, University of Sargodha, Sargodha, Pakistan

et al., 2011). Due to combination of cereals, fruit cereal bars are rich in energy, dietary fiber, antioxidants, vitamins and minerals. Protein quality of the cereal bars is poor due to deficiency of essential amino acids. However, the use of roasted black gram flour in the diet improves the overall protein quality of cereals as they are rich in lysine. Cereals are rich in the essential amino acid methionine, so they complement legumes in that way (Iqbal *et al.*, 2006).

Considering nutritional benefits of whole-grains, legumes, nuts and dates, this study was designed to prepare fruit based fiber enriched functional fruit bars for all age groups. The objectives of the study were to check the suitability of different nuts and fruit like date for the development of date based fiber enriched fruit bars and determine the effect of different nuts on physico-chemical and sensory properties of date based fiber enriched fruit bars

MATERIALS AND METHODS

This research project was conducted at Institute of Food Science and Nutrition, University of Sargodha, Sargodha. Commercially available cereal grains (wheat, rice), flakes of (corn, barley and oat), roasted grams, peanuts, almonds, pistachio nut, coconut powder and dates and skim milk powder were purchased from the local market of Sargodha. Chemicals for analyses were purchased from Sigma Aldrich (Seelze, Germany) and Lab-Scan (Dublin, Ireland) available in the local market.

Fruit bars were prepared according to the method described by Nadeem *et al.* (2012). Wheat and rice grains were soaked in water, then roasted and ground to make flour. Roasted grams were ground to make the flour. Peanuts, almonds and pistachio were crushed. Dates were pitted, washed and dried. Pitted dates were steamed for five minutes and then dried. Steamed dates were minced in the paste form with meat mincing machine.

Procedure for Development of Nutritious Fruit Bars: After the preparation of raw materials, wheat and rice flour, flakes of barley, corn and oat also nuts and skim milk powder were added and mixed in date paste. Then this material was transferred to the bar sheeting and cutting table. Sheeting was done with stainless steel roller then this sheet was cut into bars of 2.5 cm in width and 7 cm in length with the help of cutters. Each bar of approximately 25±2 g was packed in aluminum foil. Quantity of nuts was varied while other ingredients were constant.

Water activity: Water activity in fruit bars was determined by the electronic hygropalm water activity meter (Model Aw-Win, Rotronic, equipped with a Karl-Fast probe). Hygropalm water activity meter is a portable device with 9 Volts battery to measure the water activity and temperature. It was first calibrated and bars were analyzed according to method as described by Nadeem *et al.* (2011).

Texture analysis: Texture analysis of the bars was determined with the help of texture analyzer (Model TA.XT plus, Stable Microsystems, Surrey, UK) with 5 kg load cell according to the method as described by Nadeem *et al.* (2012). The texture expert program version 4.1.2 was used for data analysis. Texture determinations were made by using a 3 point bend rig for a bend test. The bars were bent in order to check structural characteristics present inside or on the surface. Samples for bending were placed centrally under the 3 point bend rig. Both the load cell and probes were calibrated before test. Hardness measurement of samples by bending involved plotting force (g) versus distance (mm). The maximum force (g) was used an index of hardness for bend test and maximum distance as fracture abilty.

Color measurement: Color of fruit bars was determined with color meter with the method described by Nadeem *et al.* (2011) with the help of color meter (color test II, Neohuaus Neotec). The color meter was calibrated with standards 151 CTn (light color) and 54 CTn (dark color). The samples were placed centrally under photocell of color meter. The reading of the color meter is compared with that of standards.

Chemical analysis of bars: Proximate composition such as moisture, ash, crude fat, crude protein and crude fiber of fruit bars was determined and expressed on dry matter basis according to the procedures given in AACC (1999).

Gross energy of fruit bars was calculated by using standard factors of 3.75 , 9.0 and 3.75 kcal/g for protein, lipid and carbohydrate respectively, the energy contents were summed to give total or gross energy of the bar samples (Livesey, 1990).

Microbiological analysis: Total plate count was done according to method No. 42-11 of AACC (1999) and yeast count was done according to method No. 42-50 of AACC (1999).

Sensory evaluation: Fruit bars were evaluated for sensory characteristics such as color, appearance, texture, flavor, mouth feel and overall acceptability at room temperature in sensory evaluation laboratory by a panel of untrained judges on 9-points Hedonic Scale (Land and Shepherd, 1988).

Statistical analysis: Results were statistically analyzed by using analysis of variance technique. The difference in means will be evaluated by the Least Significant Design (Steel *et al.*, 1997).

Table 1: Treatments of fruit bars

Treatments	Without dry fruit	Almonds (g)	Pistachio nuts (g)	Peanut (g)	Coconut (g)	Mixed dry fruit (g)
T_0	-	-	-	-	-	-
T_1	-	150	-	-	-	-
T_2	-	-	150	-	-	-
T_3	-	-	-	150	-	-
T_4	-	-	-	-	150	-
T_5		-	-	-	-	150

Table 2: Physical analysis of fruit bars

		Texture		
Treatments	Water activity (a_w)	Hardness (g)	Fractur-ability (Pa)	Color (Ctn)
T_0	0.593	2368.9	79.38	148.33
T_1	0.588	1393.4	77.92	128.00
T_2	0.582	1337.3	77.60	114.00
T_3	0.580	1488.9	78.24	132.33
T_4	0.591	1547.3	78.34	105.00
T_5	0.584	1307.4	78.15	107.67

Table 3: Proximate (%) analysis and calorific values (Kcal) of fruit bars

Treatments	MC	CF	CF	CP	AC	NFE	GE
T_0	18.14	5.90	3.15	9.82	1.90	60.80	335.67
T_1	17.76	9.81	5.58	10.87	2.7	53.28	334.95
T_2	17.70	12.97	4.59	12.01	3.15	49.57	363.06
T_3	17.91	16.08	2.16	12.91	3.29	47.64	386.96
T_4	19.21	9.80	8.07	13.15	3.61	46.14	325.46
T_5	17.62	9.06	5.56	13.63	3.93	50.18	336.84

MC: Moisture content, CF: Crude fat, CF: Crude fiber, CP: Crude protein, AC: Ash content, GE: Gross energy

RESULTS AND DISCUSSION

Physical analysis of fruit bars: The mean values of water activity for treatments varied from 0.58 to 0.59. The results indicated variation in water activity within different treatments. The highest water activity was recorded in T_0 and the lowest value was found in case of T_3, because in peanut minute quantity of moisture is available as compared to date-paste with cereals (USDA, 2012).The results of water activity for various treatments is in line with the findings of Estevez *et al.* (1995) who found water activity from 0.71 to 0.52 in cereal nut bars.

Texture is measured in terms of hardness (firmness) and fracture-ability. Mean values of hardness for treatments range from 1307.4 g to 2368.9 g. This indicates that T_0 has maximum hardness while T_5 has minimum. Hence, addition of nuts in fruit bars reduces hardness. On the other hand, fracture-ability varies from 77.60 to 79.38 Pa. Lowest score for fracture-ability was recorded in T_2 and the highest score in case of T_0. Loveday *et al.* (2010) reported the texture of the protein bars; fracture stress from 20.5 Pa to 201 Pa.

The mean color values for treatments vary from 105.00 CTn to 148.33 CTn. The maximum value of color was recorded in T_0 while T_4 has minimum value which indicated dark color.

Proximate composition of fruit bars: The mean values for proximate composition of fruit bars are given in Table 3. The mean value for moisture content varied significantly among treatments. The results regarding the change in crude moisture is in close agreement with the findings of Rehman *et al.* (2012) who observed that crude moisture content varied significantly among treatment of apricot-date bars. They observed that crude moisture content range from 7.14 to 19.21% in apricot-date bars. Ahmed *et al.* (2005) concluded that moisture content of papaya fruit bars varied significantly from 19.1 to 21.12%.

The mean values for crude fat also varied significantly. The mean values for crude fiber indicates that treatment T_4 showed highest fiber content. The results regarding the change in crude fiber is in close agreement with the findings of Rehman *et al.* (2012). The mean values for crude protein vary from 9.82 to 13.63%.The mean values for Ash content varied from 1.90 to 3.93%, indicating the mineral contents of fruit bar. The results regarding the change in crude NFE is in close agreement with the findings of Rehman *et al.* (2012). It is apparent from the results that the gross energy differs significantly among different treatments, showing their high caloric value.

Table 4: Microbial analysis of fruit bars

Treatments	Total plate count (CFU/g)	Yeast and mold count (CFU/g)
T_0	$2.28x10^3$	$1.78x10^2$
T_1	$2.46x10^3$	$1.97x10^2$
T_2	$2.38x10^3$	$1.92x10^2$
T_3	$2.44x10^3$	$1.84x10^2$
T_4	$2.27x10^3$	$1.81x10^2$
T_5	$2.37x10^3$	$1.88x10^2$

Table 5: Sensory evaluation (sores) of fruit bars

Treatment	Color	Appearance	Flavor	Texture	Mouth feel	Overall acceptability
T0	5.10	5.55	5.50	5.85	5.50	5.70
T1	6.60	6.75	6.90	6.90	6.90	6.80
T2	7.15	7.25	7.05	6.40	7.05	7.20
T3	7.10	6.45	7.05	6.90	7.05	7.10
T4	6.30	6.75	7.00	6.90	7.00	7.25
T5	7.80	7.95	7.75	7.80	7.75	7.80

Microbial analysis: The mean values for TPC of fruit bars samples have been presented in Table 4. The mean values for treatments vary from $2.27x10^3$ to $2.46x10^3$ CFU/g. The maximum value was observed by T_1 ($2.46x10^3$) and minimum value was noted in T_4 ($2.27x10^3$). The results of this study are strengthened by the earlier findings of Al-Hooti *et al*. (1997) who observed that TPC significantly varied from 1.00 to 2.18 Log_{10} CFU/g.

The mean values of Yeast and Mold Count showed that mean values for treatments range from $1.78x10^2$ to 1.97 x 10^2 CFU/g having the maximum count ($1.97x10^2$) for T_1 and minimum count ($1.78x10^2$) in case of T_0. The results of this study are strengthened by the early findings of Al-Hooti *et al*. (1997) who observed that mold and Yeast count varied significantly in date bars from 2.6 to 3.00 Log_{10} CFU/g.

Sensory evaluation of fruit bars: The mean values for color score of fruit bars vary from 5.10 to 7.80. The minimum score (5.10) was got by T_0 while T_5 has maximum value (7.80) of color; it shows that there is a significant difference in color with the variety of nuts. The mean values for appearance of fruit bars varied from 5.55 to 7.95. The minimum score (5.55) for appearance was obtained by T_0 while T_5 has maximum appearance value (7.95).

The mean values for flavor, texture also varied significantly among different treatments, as shown in Table 5. The mean values for mouth feel varied from 5.50 to 7.75. T_0 has the minimum value while T_5 has maximum value. The mean values for overall acceptability score of fruit bars indicated that T_5 has maximum 7.80 score. The overall acceptability for various treatments is in accordance with the findings of Al-Hooti *et al*. (1997) who reported overall acceptability score from 6.9 to 7.3 in date-bars.

Conclusion: Date and dried fruits can be used to prepare nutritious fruit bars of good sensory and nutritional value which provide substantial amount of carbohydrates, proteins, fats, dietary fiber, minerals and bioactive compounds.

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