Kashmir Journal of Science
https://kjs.org.pk **ISSN: 2958-7832**

Kashmir Journal of Science (2025), 4(1): 1-15

Research Paper

Development and Quality Evaluation of Fiber-Fortified Date Bars

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ARTICLE INFO

Article history:

Received: 30 January 2025
Accepted: 13 February 2025
Available online: 17 March 2025

Keywords:
Date fruit bars,
Fiber fortification,
Functional foods,
Quality evaluation

Abstract

Date bars are energy-dense snack foods developed from dried date fruits and sometimes enriched with other ingredients. They are popular functional foods for people who are looking for healthy snack options. Date bars can be fortified with different nutritional sources to overcome nutritional deficiencies among consumers. The present study was conducted to develop fiber-fortified date bars using rice bran, coconut powder, and nuts (almond, pistachio, and peanuts) with date paste as fiber sources and to examine their nutritional, microbiological, and sensorial characteristics. A total of five different formulations were developed and coded as T_0 (control/ without fiber sources), T_1 (120 g date paste + 15 g rice bran), T_2 (120 g date paste + 15 g coconut powder), T_3 (120 g date paste + 15 g nuts), T_4 (120 g date paste + 5 g each of rice bran, coconut powder, and nuts). Among the treatments, T_0 showed significantly higher moisture content (25.44%), TSS (64 ^{o}Brix), and non-reducing sugar (15.03%). T_1 showed significantly higher titratable acidity (2.9%), Mg (2855.88 ppm), and Zn (48.88 ppm). T_2 showed significantly higher crude fiber (8.92%), ash (2.75%), fat (6.34%), and reducing sugar (57.84%). T_3 showed significantly higher protein (5.18%), and Mn (4.06 ppm) while T_4 showed significantly higher Fe (8.44 ppm) and total sugars (65.69%). The results of the sensory analysis revealed T_3 having the highest scores for most sensory attributes followed by T_2, T_4, and T_1 while the control treatment (T_0) received the lowest sensory scores. It can be concluded from the present study that fortifying date bars with different fiber sources improved their nutritional value, especially fiber content while maintaining an acceptable total plate count. Thus, these functional snack foods can be served to consumers for better health.

Introduction

Snacking has become a popular habit among people, and there is a growing awareness of the importance of healthy snacking for human health and nutrition. This has led to an increased demand for healthy snack products, driving food manufacturers to develop new products to meet consumer needs (Ishak *et al.,* 2021; Ihuoma *et al.,* 2022). The nutritional content of ingredients used in snack bars affects the product's nutrients and energy value. When selecting ingredients, the dietary needs of consumers are often considered (Maia *et al.,* 2021). Consumers are increasingly preferring convenient, natural, and nutritious food products with minimal processing. Fruit bars meet these criteria and have a longer shelf life than fresh fruits. They provide high dietary fiber, proteins, carbohydrates, micronutrients, and other bioactive compounds that are essential for meeting the body's daily requirements (Munir *et al.,* 2018). Fruit bars tend to be more attractive among consumers than fresh fruits since they provide more balanced nutrients (Ali, 2024).

A fruit bar, also known as a fruit slab, is a dehydrated snack or dessert made from pulpy fruits or a mixture of commercially popular fruit pulps. It is a nutritious snack made from fruit pulps that provides high levels of vitamins and minerals (Devi *et al.,* 2018). Fruit bars are typically made using fruit pulps, but other ingredients and additives may be included to enhance their nutritional value and sensory characteristics. Researchers have explored different fruits and ingredients to develop nutritious fruit bars, which can help overcome nutritional deficiencies and promote healthy snacking habits (Irshad *et al.,* 2022).

Instead of relying heavily on snacks prepared using refined sugar, the use of natural sweeteners such as date (*Phoenix dactylifera* L.) is preferable on health grounds (Ibrahim *et al.,* 2021). As for the nutritional composition, the date palm fruit is an attractive option for developing snack bars. Although they are known as a rich source of carbohydrates, date fruits also provide a high quantity of good quality nutrients, including dietary fiber (i.e., β-glucans), and unsaturated fatty acids (i.e., oleic, and linoleic acids), as well as significant amount of micronutrients including riboflavin, niacin, tocopherols, potassium, and calcium. Dates are generally low in protein, though according to several studies, date fruits contain essential amino acids such as lysine and histidine which are deficient in most fruits. In addition, date fruits also contain different types of bioactive phytochemicals including phenolic acids, polyphenols, and carotenoids in significant amounts (Hussain *et al.,* 2020; Hamad *et al.,* 2015).

Dietary fiber found in plants mainly consists of cellulose, hemicellulose, pectin, lignin, gums, and mucilage (Dhingra *et al.,* 2012). Regular intake of dietary fiber contributes to several health benefits including prebiotic activity, decreased risk of coronary heart disease, hypertension, obesity, as well as gastrointestinal diseases in some cases (Trinidad *et al.,* 2006). In general, increased intake of fiber has a beneficial effect on human health. In recent years, the intake of dietary fiber has garnered more attention in food products because of inadequate dietary fiber consumption when considering the daily recommended intake. To increase dietary fiber intake, dietary fiber-fortified foods are recommended (Pratiwi *et al.,* 2019).

Rice bran is the abundant by-product produced during whole rice grain milling. However, it is commonly utilized as animal feed and the extent of use of rice bran is limited. With high contents of dietary fibers specifically cellulose, hemicellulose, pectin, arabinoxylan, lignin, β-glucan, and phenolic acids, this by-product has large potential (Henderson *et al.,* 2012). Coconut powder is a good source of dietary fiber, containing 60.9% total dietary fiber, including 56.8% insoluble fiber and 3.8% soluble fiber. It has great potential to be added to food products to improve the physical chemical and nutritional properties of the product (Jiamjariyatam *et al.,* 2022; Trinidad *et al.,* 2006). Almonds have the highest fiber content among nuts, with 11.8-13.0%. Pistachios contain 10.3% fiber, while peanuts contain 8% fiber (Amarowicz *et al.,* 2017; USDA, 2015).

Therefore, the present study was conducted to develop fiber-enriched date bars using rice bran, coconut powder, and nuts (almonds, pistachio, and peanuts) as fiber sources as these ingredients are known to have a good content of both soluble and insoluble fiber and to analyze their effect on the nutritional, microbial quality, and sensorial characteristics of the developed date bars.

Materials and Methods

Procurement of raw material

Date fruits, skim milk powder, nuts (almonds, pistachios, and peanuts), rice bran, coconut powder, chickpea, and corn flour were purchased from the local market of Islamabad, Pakistan.

Pre-treatment of raw materials

Date paste preparation

Date paste was developed by following the method of Irshad *et al.* (2022) with minor modifications. Date fruits were washed, air-dried, pitted, and steamed (for 20-25 minutes). To obtain the date paste, mincing of these dates was done in a mincing machine.

Preparation of raw materials

Nuts (almonds, pistachios, and peanuts) and chickpeas were powdered using an electric grinder.

Development of date bars

Date bars were developed by following the method of Irshad *et al.* (2022) with minor modifications. All ingredients (i.e., skim milk powder, rice bran, coconut powder, nuts, and chickpea flour) were properly mixed with date paste separately and transferred to the cutting table. The corn flour was used as a duster to make molding easy. The contents were sheeted using a stainless-steel roller. The sheet was cut with molder into 3 cm wide, 7 cm long, and 1.5 cm thick bars. Each bar of approximately 25g was packed and sealed in an airtight aluminum package. Table 1 presents the information regarding the ingredients used in date bars while Table 2 exhibits the formulation of all date bar treatments.

Table 1. Information regarding the ingredients used in date bar formulation

Ingredients	Quantity (g)
Date fruits	600 g
Skim milk powder	50 g
Chickpea flour	25 g
Corn flour	20 g
Rice bran	20 g
Coconut powder	20 g
Almonds	10 g
Pistachio	10 g
Peanuts	10 g

Table 2. The treatment plan for date bars per 120 g date paste

Treatments	Rice Bran	Coconut Powder	Nuts
T_0	-	-	-
T_1	15g	-	-
T_2	-	15g	-
T_3	-	-	15g
T_4	5g	5g	5g

T_0 = Control (No fiber sources), **T_1** = Date bars with 15g rice bran, **T_2** = Date bars with 15g coconut powder, **T_3** = Date bars with 15g nuts, **T_4** = Date bars with 5g each of rice bran, coconut powder, and nuts.

Nutritional assessment of date bars

The moisture, ash, dietary fiber, TSS (Total soluble solids), protein, fat, and titratable acidity of date bars were observed according to the standard methods of AOAC (2016).

Lane and Eynon method No. 925-36 of AOAC (2000) was followed to determine total sugars, reducing sugars, and non-reducing sugars.

For mineral analysis, the samples underwent ashing in a furnace at a temperature of 550^{o}C. After ashing, the digestion process was performed on the resulting dry ash, involving the addition of a mixture of 6m HCL and 0.1 MHNO_3 in equal proportions. Following dilution, the mineral content was determined using atomic absorption spectrophotometry, by the method of AOAC (2016).

Microbiological analysis

The total plate count was analyzed by the procedure followed by Swanson *et al.* (2001).

Analysis of sensory attributes

The sensorial attributes of fiber-enriched date bars i.e., color, flavor, texture, aroma, and overall acceptability were determined as per the method described by Iwe (2002). The nine-point hedonic scale was used to determine the sensorial characteristics of the date bar samples. The 9-point Hedonic scale has scores points from 1 to 9 revealing the desirability of the food products as per the judgment of panelists (Like Extremely, Like Very Much, Like Moderately, Like Slightly, Neither Like nor Dislike, Dislike Slightly, Dislike Moderately, Dislike Very Much, Dislike Extremely i.e., from 9 to backward till 1, respectively).

Statistical analysis

Analysis of variance (ANOVA) was used to statistically assess the results that were obtained. According to Steel *et al.* (1997), the Least Significant Difference (LSD) test was used with Statistix 8.1 software to evaluate the mean difference.

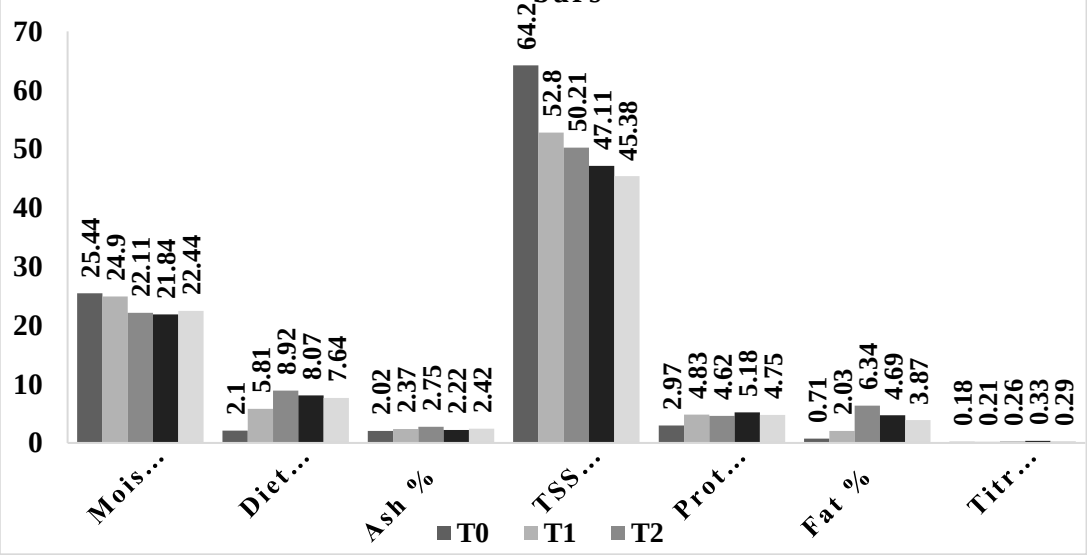
Results and Discussion

Nutritional assessment of fiber-fortified date bars

The nutritional assessment of fiber-fortified date bars revealed significant variations among treatments (Fig. 1). Moisture content ranged from 21.84% to 25.44%, with the highest values observed in T_0 (25.44%) and the lowest in T_3 (21.84%). This relates to the research by Shaheen *et al.* (2013) who observed moisture content to be inversely proportional to the addition of different ingredients in date fruit-based bars. Similarly, Rehman *et al.* (2020) observed the control treatments to have higher moisture content as compared to the treatment with added fiber sources in date bars. Dietary fiber content differed notably, with values ranging from 2.10% to 8.92%, the highest values in T_2 (8.92%), and the lowest in T_0 (2.10%). The observed results support the previous studies by Shaheen *et al.* (2013) and Rehman *et al.* (2020) who observed that the addition of ingredients like oat bran and coconut flour significantly increased the fiber content of date bars. A study by Singh *et al.* (2023) determined that date paste had 2.30% crude fiber as observed in the control treatments in the present study and the addition of different fiber sources raised the fiber content to 8.92% which shows the sources utilized as fiber sources have a positive impact on the final products. A balanced diet must include fiber since it is vital for preserving digestive health and controlling blood sugar levels. Fruit snacks with added fiber provide higher nutritional value and promote satiety, which keeps people feeling fuller for longer (Taştan, 2023). According to Hussain *et al.* (2020), dates are a superior source of dietary fiber compared to cereals because they include high-quality fiber fractions like β-glucans, arabinoxylans, and cellulose. Ash content varied between 2.02% and 2.75%, with the highest values in T_2 (2.75%) and the lowest in T_0 (2.02%). The addition of fiber sources showed an increased ash content in fiber-fortified date bars with the coconut powder added treatment showing the highest values followed by the treatment added with rice bran. The date fruits have sufficient total mineral or ash content ranging from 1 to 2.5% (Ashraf and Hamidi-Esfahani, 2011). The results regarding the changes in ash content are highly consistent with the findings of Irshad *et al.* (2022) who observed a higher ash content in date bars with the addition of different protein sources. Total soluble solids (^{o}Brix) ranged from 45.38 to 64.2

°Brix, with the highest results in T_0 (64.2 °Brix) and the lowest results in T_4 (45.38 °Brix). The results obtained are in line with the findings of Rehman *et al.* (2020) who observed a TSS ranging from 51.0 to 66.44 °Brix in date bars fortified with different natural fiber sources. Protein content ranged from 2.97% to 5.18%, with T_3 (5.18%) having the highest and T_0 (2.97%) having the lowest values. Comparing the fiber-fortified date bars to the control sample, the results showed a noticeable rise in protein content. In other words, the protein content of the date bars was enhanced by the addition of fiber sources. According to Ashraf and Hamidi-Esfahani (2011), date fruits lose protein content during ripening due to non-enzymatic browning/Maillard reaction, however during maturity stage, date fruit has a self-sufficient protein content (i.e., 1 to 7%). Fat content varied from 0.71% to 6.34%, with T_2 (6.34%) having the highest and T_0 (0.71%) the lowest values. When dates are fresh (kimri stage), their fat content is approximately 0.14 g/100 g, and when they are dried (tamer stage), it is 0.38 g/100 g. Date flesh does not contain as much nutritious value as the skin, which contains lipids that are primarily concentrated there and are more important for protecting the fruit. Seeds can consist of up to 8.49% of fresh weight when it comes to lipids, which is often more than in flesh (Lieb *et al.*, 2020). Titratable acidity levels fluctuated from 0.18% to 0.33%, with T_3 (0.33%) showing the highest and T_0 (0.18%) the lowest. The observed TA content from different samples indicates variation in the concentration of organic acids present in the samples. Similar results were also observed by Irshad *et al.* (2022) and Rehman *et al.* (2020) in date bars fortified with different protein and fiber sources.

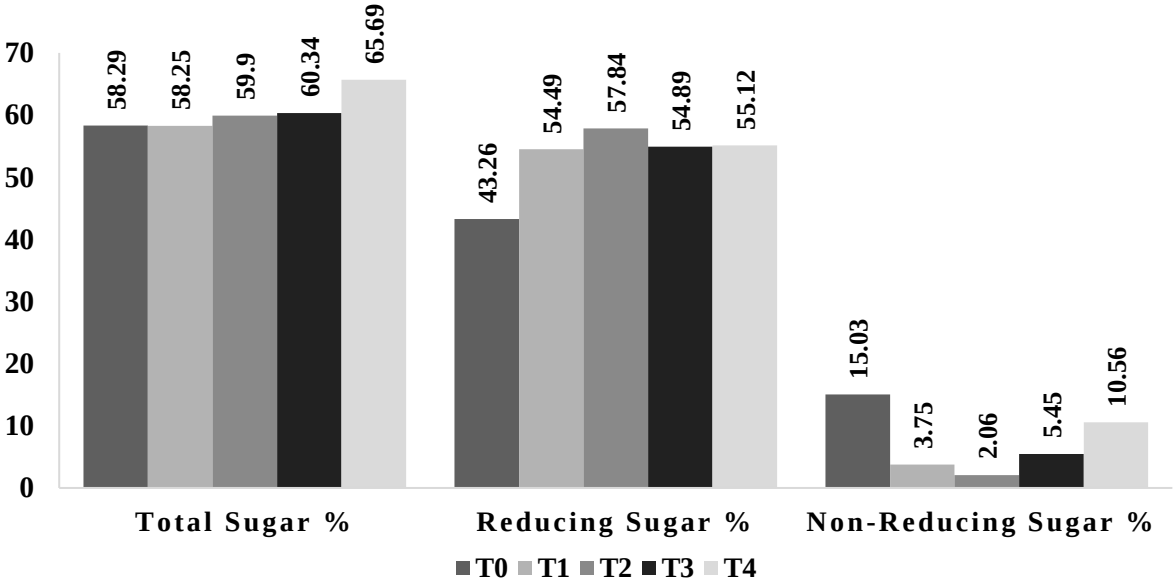
Figure 1. Nutritional analysis of fiber-fortified date bars



Sugar content of fiber-fortified date bars

Carbohydrates, which include reducing sugars like glucose and fructose as well as non-reducing sugars like sucrose, and trace amounts of polysaccharides like cellulose and starch, make up most of the chemical content of dates (Aljaloud *et al.*, 2020). The sugar assessment of fiber-fortified date bars revealed significant variations among treatments (Fig. 2). Mean reducing sugar content ranged from 57.84% to 43.26%, with the highest values in T_2 (57.84%) and the lowest values in T_0 (43.26%). Values for non-reducing sugars ranged from 15.03% to 2.06%, with T_0 (15.03%) having the highest values and the lowest values in T_2 (2.06%). Values for total sugars ranged from 65.69% to 58.25%, with the highest values recorded in T_4 (65.69%) and the lowest values recorded in T_1 (58.25%). Similarly, Munir *et al.* (2018) also observed similar sugar contents in date bars enriched with oat flour.

Figure 2. Sugar content of fiber-fortified date bars

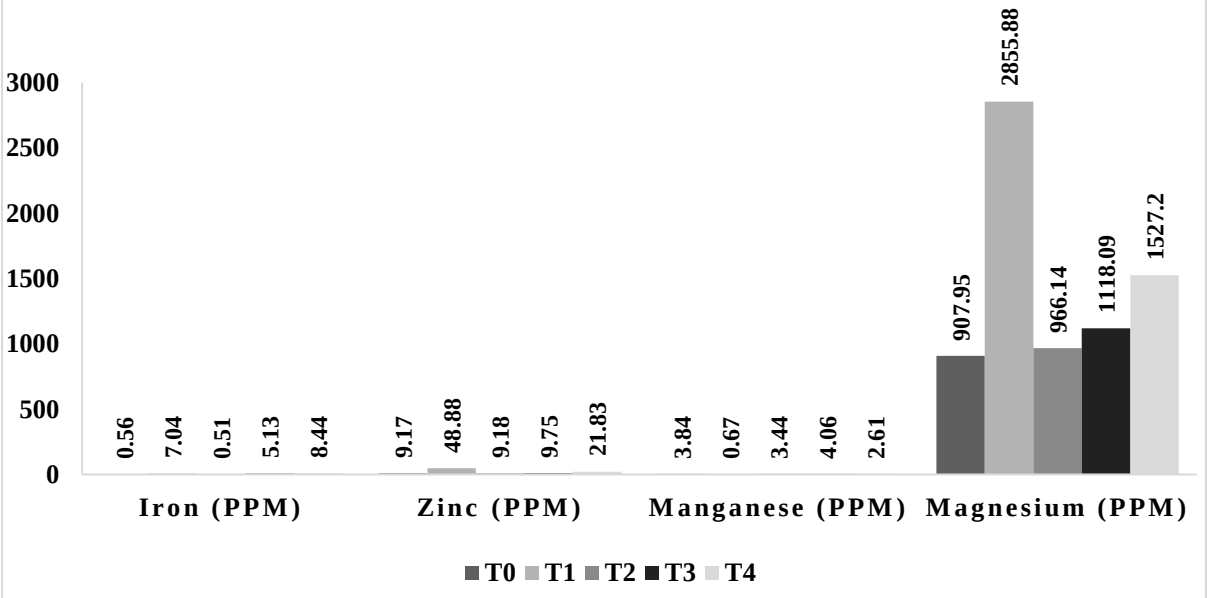


Minerals content of fiber-fortified date bars

Minerals are one of the main components of date palms that contribute to their nutritional value. At least fifteen important minerals, such as phosphorus, potassium, sodium, zinc, manganese, magnesium, copper, and iron, are present in date fruits (Tripler *et al.*, 2011). According to El-Hadrami and Al-Khayri (2012), minerals are necessary nutrients for the health of muscles, nerve cells, soft tissues, teeth, bones, and hemoglobin. Agronomic techniques, ripening stage, cultivar, and environmental factors all affect the amount of minerals in a crop (Tripler *et al.*, 2011; Al-Farsi & Lee, 2008). The mineral content of fiber-fortified date bars varied across different treatments (Fig. 3). Mean iron (Fe) content ranged from 0.56 ppm to 8.44 ppm, with the highest values observed in T_4 (8.44 ppm) and the lowest in T_2 (0.05 ppm). Iron is part of

hemoglobin, the pigment of red blood cells, which binds to oxygen and facilitates its transport from the lungs via the arteries to all cells throughout the body. Iron is also necessary for the process of hematopoiesis, which is the production of red blood cells (Abbaspour *et al.*, 2014). The Dietary Guidelines for Americans (2010) recommends an iron-rich diet of 7 mg for children and 18 mg for adults. Zinc (Zn) content ranged from 9.17 ppm to 48.88 ppm, with T_1 (48.88 ppm) showing the highest and T_0 (9.17 ppm) the lowest values. According to Norman and Hotchkiss (2007), zinc is a component of all living things and is necessary for taste, eyesight, and wound healing in addition to hundreds of other biological processes, such as blood clotting and enzyme reactions. Manganese (Mn) levels varied from 0.67 ppm to 4.06 ppm, with T_3 (4.06 ppm) showing the highest and T_1 (0.67 ppm) the lowest values. The trace mineral manganese is still essential for supporting bone growth and metabolic processes. Magnesium (Mg) content ranged from 907.95 ppm to 2855.88 ppm, with T_1 (2855.88 ppm) showing the highest and T_0 (907.95 ppm) the lowest values. Magnesium offers elasticity to prevent injuries. Together with calcium, magnesium aids in blood clotting, muscle contraction, and the regulation of blood pressure (Norman and Hotchkiss, 2007). Similar results of mineral content were also recorded by Rehman *et al.* (2020) by the addition of different natural fiber sources to the date bars.

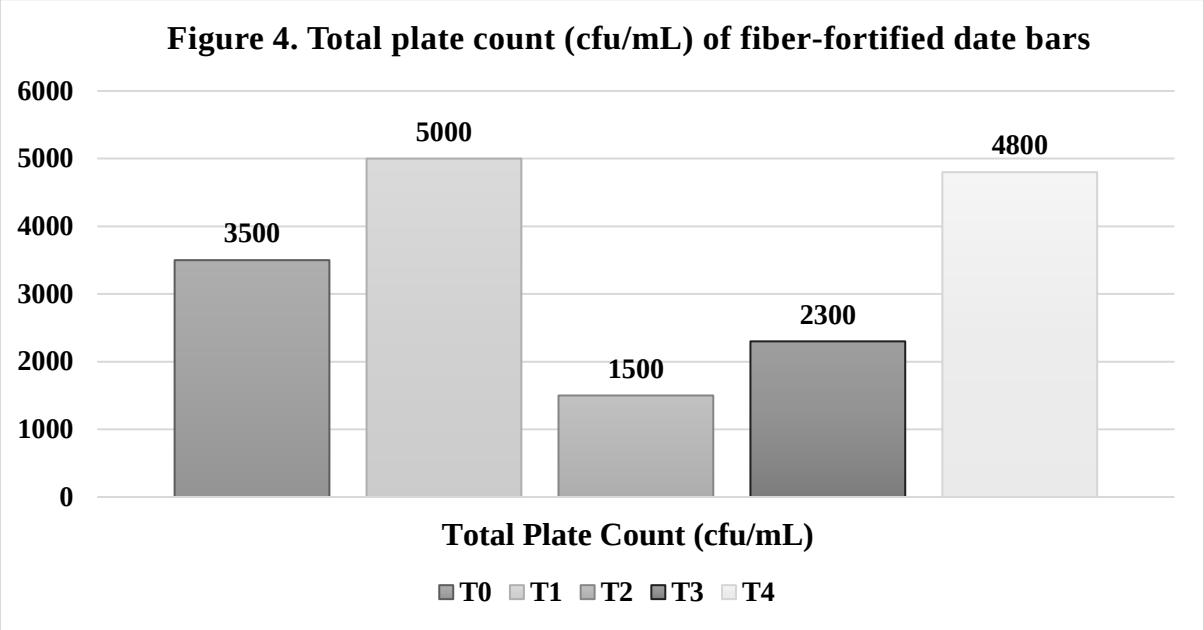
Figure 3. Mineral profile of fiber-fortified date bars



Microbiological quality of date bars

The results of total plate count contents of fiber-fortified date bars are shown in Figure- 4. Mean values for total plate count contents were 3.5×10^3, 5×10^3, 1.5×10^3, 2.3×10^3 and 4.8×10^3

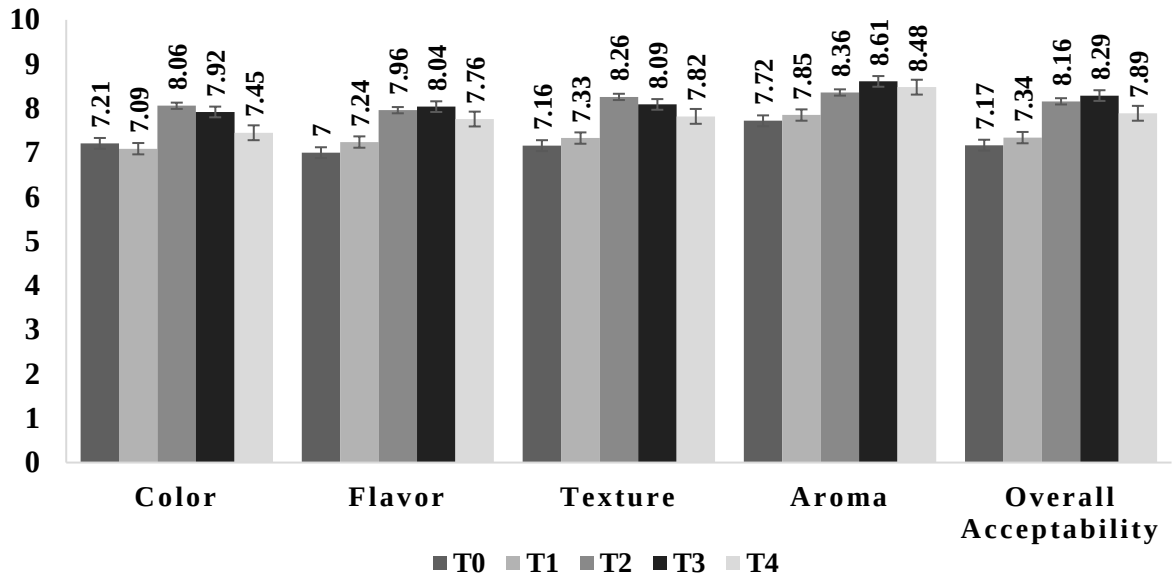
Log_{10}CFU/g for T_0 to T_4 respectively. The maximum value was achieved in T_1 (5×10^3), and the minimum was in T_2 (1.5×10^3). The observed results are supported by Rehman *et al.* (2020) who also recorded similar results for total plate count in date bars enriched with different fiber sources.



Sensory Evaluation

The results of sensory attributes of fiber-fortified date bars showed significant variations among treatments (Fig. 5). Overall, the treatment T_3 (with 15g of nuts) showed the highest results across all parameters, especially in flavor (8.04), aroma (7.61) and overall acceptability (7.96) and was followed by the treatment T_2 (with 15g coconut powder) showing favorable scores in all attributes tested. The treatment T_4 (with 5g each of rice bran, coconut powder, and nuts) also showed good scores. Treatment T_1 (incorporated with 15g of rice bran) also showed satisfactory scores across most attributes. The control treatment T_0 (without any fiber sources) received lower scores as compared to the fiber-fortified treatments. Overall, the whole treatments were liked by the judges, but the fiber-incorporated treatments were liked the most. The incorporation of fiber sources especially nuts, and coconut powder contributed positively to the sensory characteristics, enhancing the desirability of the date bars. Similar results were also observed by Irshad *et al.* (2022) who noted higher scores for sensory attributes by the date bar treatments enriched with different protein sources in comparison to the control samples.

Figure 5. Snesory attributes of fiber-fortified date bars



Conclusion

Based on the observed results of the present study, it can be concluded that fortifying date bars with these fiber sources (rice bran, coconut powder, and nuts) improved their overall nutritional profile while in particular the fiber content was effectively enhanced. Each treatment exhibited unique characteristics and compositional differences. Overall, the development of fiber-enriched date bars presents a promising opportunity to offer nutritious and functional snack

options to consumers seeking healthier alternatives to sugar-based snacks available in the local markets.

Acknowledgement

The authors acknowledge Food Science and Product Development Institute (FSPDI), NARC, Islamabad for the provision of required facilities to conduct the research.

References

Abbaspour, N., Hurrell, R., and Kelishadi, R. (2014). Review on iron and its importance for human health. *Journal of Research in Medical Sciences: the official journal of Isfahan University of Medical Sciences*, *19*(2), 164.

Al-Farsi, M.A., and Lee, C.Y. (2008). Nutritional and functional properties of dates: a review. *Critical Reviews in Food Science and Nutrition*, *48*(10), 877-887. https://doi.org/10.1080/10408390701724264

Ali, R.F. (2024). Quality evaluation of snack bars prepared using different proportions of Khudri dates and fried green lentil (*Lens culinaris* Medik.). *Cogent Food & Agriculture*, *10*(1), 2300880. https://doi.org/10.1080/23311932.2023.2300880

Aljaloud, S., Colleran, H.L., and Ibrahim, S.A. (2020). Nutritional value of date fruits and potential use in nutritional bars for athletes. *Food and Nutrition Sciences*, *11*(6), 463-480. https://doi.org/10.4236/fns.2020.116034

Amarowicz, R., Gong, Y., and Pegg, R.B. (2017). Recent advances in our knowledge of the biological properties of nuts. *Wild plants, mushrooms and nuts: Functional Food Properties and Applications*, 377-409. https://doi.org/10.1002/9781118944653.ch11

AOAC, (2000). Official Methods of Analysis. 17th Ed., Association of Official Analytical Chemists (AOAC). Arlington, VA, USA.

AOAC, (2016). Official methods of analysis of AOAC international. 20th Edition. Association of the Official Analytical Chemists, Gaithersburg.

Ashraf, Z., and Hamidi-Esfahani, Z. (2011). Date and date processing: A review. *Food Reviews International*, *27*(2), 101-133. https://doi.org/10.1080/87559129.2010.535231

Devi, M., Vyas, S.R., and Kaur, J. (2018). Preparation and quality assessment of apple bar from different varieties. *Asian Journal of Dairy and Food Research*, *37*(3), 242-245. https://doi.org/10.18805/ajdfr.DR-1354

Dhingra, D., Michael, M., Rajput, H., and Patil, R.T. (2012). Dietary fibre in foods: a review. *Journal of Food Science and Technology*, *49*, 255-266. https://doi.org/10.1007/s13197-011-0365-5

El Hadrami, A., and Al-Khayri, J.M. (2012). Socioeconomic and traditional importance of date palm. *Emirates Journal of Food and Agriculture*, *24*(5), 371-385.

Hamad, I., AbdElgawad, H., Al Jaouni, S., Zinta, G., Asard, H., Hassan, S., Hegab, M., Hagagy, N., and Selim, S. (2015). Metabolic Analysis of Various Date Palm Fruit (*Phoenix dactylifera* L.) Cultivars from Saudi Arabia to Assess their Nutritional Quality. *Molecules*, *20*(8), 13620–13641. https://doi.org/10.3390/molecules200813620

Henderson, A.J., Ollila, C.A., Kumar, A., Borresen, E.C., Raina, K., Agarwal, R., and Ryan, E.P. (2012). Chemopreventive properties of dietary rice bran: current status and future prospects. *Advances in Nutrition*, *3*(5), 643-653. https://doi.org/10.3945/an.112.002303

Hussain, M.I., Farooq, M., and Syed, Q.A. (2020). Nutritional and biological characteristics of the date palm fruit (*Phoenix dactylifera* L.)–A review. *Food Bioscience*, *34*, 100509. https://doi.org/10.1016/j.fbio.2019.100509

Ibrahim, S.A., Fidan, H., Aljaloud, S.O., Stankov, S., and Ivanov, G. (2021). Application of date (*Phoenix dactylifera* L.) fruit in the composition of a novel snack bar. *Foods*, *10*(5), 918. https://doi.org/10.3390/foods10050918

Ihuoma, A., Marvellous, O.I., and Ndukwe, M. (2022). Microbiological, nutritional and sensory evaluation of snack bars developed using Bambara groundnut (*Vigna subterranean* L.) and maize (Zea mays). *African Journal of Microbiology Research*, *16*(1), 8-23. https://doi.org/10.5897/ajmr2021.9583

Irshad, A., Solangi, K.A., Marri, A., Shaikh, N., Khan, A., and Dawood, M. (2022). Fortification of Date Bars with Different Protein Sources and their Nutritional

Profiling: Nutritional Value of Date Bars. *Biological Sciences-PJSIR*, *65*(2), 129-134. https://doi.org/10.52763.PJSIR.BIOL.SCI.65.2.2022.129.134

Ishak, S.F., Majid, H.A.M.A., Zin, Z.M., Zainol, M.K.M., and Jipiu, L.B. (2021). A preliminary study on snack bar formulation based on gum Arabic. *Proceedings of Research and Innovation Poster Competition (RIPC) Series,* 1/2021.

Iwe, M.O. (2002). Handbook of Sensory Methods and Analysis. Rojoint Communication Services Ltd, Uwani-Enugu.

Jiamjariyatam, R., Roskhrua, P., and Attiwittayaporn, S. (2022). Effect of coconut flour on biscuit quality. *Journal of Culinary Science & Technology*, *20*(3), 278-292. https://doi.org/10.1080/15428052.2021.1978362

Lieb, V.M., Kleiber, C., Metwali, E.M., Kadasa, N.M., Almaghrabi, O.A., Steingass, C.B., and Carle, R. (2020). Fatty acids and triacylglycerols in the seed oils of Saudi Arabian date (*Phoenix dactylifera* L.) palms. *International Journal of Food Science & Technology*, *55*(4), 1572-1577. https://doi.org/10.1111/ijfs.14383

Maia, L.C., Nano, R.M.W., Santos, W.P.C.D., de Oliveira, F.S., Barros, C.O., and de Souza Miranda, K.E. (2021). Evaluation of the nutritional quality of cereal bars made with pulse flours using desirability functions. *Food Science and Technology International*, *27*(8), 702-711. https://doi.org/10.1177/1082013220983080

Munir, M., Nadeem, M., Qureshi, T.M., Qayyum, A., Suhaib, M., Zeb, F., and Ashokkumar, M. (2018). Addition of oat enhanced the physico-chemical, nutritional and sensory qualities of date fruit based snack bars. *Journal of Food and Nutrition Research*, *6*(4), 271-276.

Norman, N.P. and Hotchkiss, J.H. (2007). Nutritive aspect of food constituents. Food Science. 5th Ed. 60- 61. https://doi.org/10.1007/978-1-4615-4985-7_4

Pratiwi, I.A., Kemsawasd, V., and Winuprasith, T. (2019). Storage Stability of High Fiber Snack Bar. *GHMJ (Global Health Management Journal)*, *3*(3). https://doi.org/10.35898/ghmj-33456

Rehman, W.U., Shah, U., Rabi, K., Munir, M., Saleeem, A., Iqbal, A., Shah, F., Shah, S., Khan, Z.U., Hamayun, M., and Hussain, A. (2020). Development fiber enriched date bars from natural resources. *Fresenius Environmental Bulletin, 29*(7 A), 6126-6133.

Shaheen, B., Nadeem, M., Kauser, T., Mueen-ud-Din, G., and Mahmood, S. (2013). Preparation and nutritional evaluation of date based fiber enriched fruit bars. *Pakistan Journal of Nutrition, 12*(12), 1061-1065. https://doi.org/10.3923/pjn.2013.1061.1065

Singh, V., Aggarwal, P., Kaur, S., and Kaur, N. (2023). Development, characterization, and shelf life studies of phytonutrient-rich date bar from immature dates (*Pheonix dactylifera* L.). *Biomass Conversion and Biorefinery, 13*(16), 14573-14584. https://doi.org/10.1007/s13399-022-03010-1

Steel, R.G.D., Torrie, J.H., and Dickey, Q. (1997). Principles and procedures of Statistics. A Biomaterial Approach 3rd Edition. McGraw Hill Book Co. Inc. New York. USA.

Swanson, K.M.J., Petran, R.L., and Hanlin, J.H. (2001). Culture methods for enumeration of microorganisms. In: *Compendium of methods for the microbiological examination of foods*. Washington, DC. American Public Health Association. (4); p. 53–62.

Taştan, Ö. (2023). Effect of Dietary Fiber Enrichment on Quality Characteristics and Consumer Acceptance of Fruit Snacks. *Akademik Gıda, 21*(4), 343-352. https://doi.org/10.24323/akademik-gida.1422812

Trinidad, P.T., Mallillin, A.C., Valdez, D.H., Loyola, A.S., Askali-Mercado, F.C., Castillo, J.C., Encabo, R.R., Masa, D.B., Maglaya, A.S., and Chua, M.T. (2006). Dietary fibre from coconut flour: a functional food. *Innovative Food Science & Emerging Technologies, 7*(4) 309–317. https://doi.org/10.1016/j.ifset.2004.04.003.

Tripler, E., Shani, U., Mualem, Y., and Ben-Gal, A. (2011). Long-term growth, water consumption and yield of date palm as a function of salinity. *Agricultural Water Management, 99*(1), 128-134. https://doi.org/10.1016/j.agwat.2011.06.010

USDA, (2015). USDA National Nutrient Database for Standard Reference, Release 28 (2015). Retrieved on Nov. 23, 2020.