Journal of Food and Dietetics Research (2022) 2(1):1–8
DOI: 10.48165/jfdr.2022.2.1.1

JFDR

Review Article

ISSN 2770-0259 (Online)

Millets (nutricereal)anditsvalue-addition:A review of the health benefits and future prospects

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ABSTRACT

Today, feeding an exponentially growing population with increasing public health issues and global climate change is a significant challenge for many developing countries like India. To counter these issues, either we can increase production, spend a considerable amount on the public health sector, or look for other affordable and healthy alternatives such as millets. Millets can help tackle health challenges such as obesity, diabetes, and lifestyle problems for gluten-free properties, have a low glycemic index, and are high in dietary fiber and antioxidants. This paper reviews the prospects of millets to combat climate-change issues and achieve food and nutritional security. This review was done to highlight the nutritional values, health benefits, availability, and future prospectus of the millet and its value addition. The findings of the paper reveal that millets are ignored since the Green Revolution in India. There is a strong need to develop high value-added products from millets to streamline this crop with other staples to increase its consumption, such as a nutrition bar to meet modern world needs.

Key words: Millets, Nutricereal, Value-added products, Health benefits, Climate-change

Introduction

Agricultural productivity is adversely affected by increased temperature and reduced water supply dueto unpredictable weather conditions, with significant production and productivity improvements.[1] Global climate change is hampering agricultural production and threatening food security systemsfor numerous arid-zone countries worldwide.[2] It is projected that in the coming years, the poorurban populations are most vulnerable to food insecurity because of climate-change intensifiedproblems such as rising temperature, irregular rainfalls, and floods.[3] A significant challenge forthe entire world is how we will feed the forecasted population of 2050, that is, 900 crores. It willbe challenging to ensure a healthy (includes essential micronutrients) and complete meal (sufficient-calories) for every individual, which otherwise will lead to malnourishment or Hidden hunger.[4]

India produces approximately 50% of the world's total production of millets; however, India'sarea under production has decreased from 18.66 million hectares to 9.11 million hectares.Still, approximately 46% of children below the age of five are moderate-to-life-threateningunderweight, 38% are average-to-severe dwarfed, and roughly 19% are moderate-to-severefutile,[5] resulting in India's worst performance in the Human Development Index (2015) with123rd rank out of 162 nations. India spent approximately 0.8–2.4% of gross domestic product(GDP) on nutrients malnutrition mitigation. Thus, the focus areas must be on identifying cropswith enhanced nutraceutical value and enhanced climate-change stress tolerance that could betransformed into modern value-added products for human consumption.[6] One such significant

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Received 06-11-2021; Accepted 27-01-2022

crop is millet in its nutraceutical values, health benefits, and climate resilience.[1,7,8] In this line, this paper reviews the prospects of millets to combat climate-change issues and achieve food and nutritional security.

MILLETS FOR SUSTAINABLE DEVELOPMENT

In many underdeveloped countries, millets are critical staple foods due to their climate-resilient nature, such as irregular precipitation. Millet comprises the high levels of proteins, minerals, vitamins, antioxidants, and diets that shape non-gluten and non-acid compared to other cereals and are thus named nutritious millet "*nutricereals.*"[9] It is also considered the most appropriate hunger crop since it can be conveniently reserved for rough times.[10]

An exceptional millet, that is, finger millet, [Figure 1] can be cultivated using minimal resources, grow in extreme weather conditions, drought-tolerant, and is richer in many micronutrients.[7] However, it could not secure its position among modern staple crops and was undervalued for a long time. Luckily, this species has had its biodiversity reserved. The undernourishment, food availability, and decreased agricultural output have caused a rise in the need for climate-resilient crops.[11] In such a situation, millets have received agricultural researchers' least attention for their exceptional ability to sustain under rising temperatures, inferior soil quality, and drought conditions.

Nutritional aspects

Many millets are complex carbohydrates responsible for their slow digestion and are also abundant in dietary fiber. They contain phenolic compounds and phytochemicals, which have culinary properties.[12] Little millet [Figure 2] includes 840% more fat, 350% richer in fiber, and 1229% more in iron content than rice.[13] Since millets are gluten-free, they are healthy for a person with allergies to glutinous foods. It will be useful as a staple diet for people with celiac conditions.[14] It is acknowledged that the prevalence of diabetes mellitus and related gastrointestinal system conditions are significantly lower in the population who use millets as their dietary cereal.[9] Millets prevail in minerals (calcium, potassium, and magnesium), dietary fiber, and phenolic content, making them superior to other cereals.[15] Kodo millet [Figure 3] with 10.3% phenolic content is the richest among all small millets [as depicted in Table 1].[15]

Table 1: Phenolic content and reducing capacity of different millets.

Source	Phenolic content (%)	Reducing capacity (%)
Finger millet	7.2±0.57	5.7±1.15
Foxtail millet	2.5±0.56	4.8±1.15
Proso millet [Figure 4]	3.4±0.58	2.6±0.20
Kodo millet	10.3±1.15	4±1.73

Millets are rich in carbohydrates (55–80%), relatively lower amount of protein than other cereals; fat percentage varies

Figure 1: Finger millet panicles.[9]

Figure 2: Little Millet Panicles.[9]

Figure 3: Kodo millet panicles.[9]

Table 2: Proximate composition and dietary fiber (per 100 g, dry weight basis)

Name	Carbohydrate (g)	Crude Protein (g)	Fat (g)	Crude Fiber (g)	Ash (g)	Energy (kcal)
Finger millet	60.0–80.0	7.0–10.0	1.3–1.8	3.6–4.2	2.6–3.0	328–336
Pearl millet	60.0–76.0	12.0–14.0	4.8–5.7	2–2.5	2.0–2.2	363–412
Foxtail millet	59.0–70.0	11.2–15.0	4.0–7.0	4.5–7.0	2.0–3.5	330–350
Kodo millet [Figure 5]	66.0–72.0	8.0–10.0	1.4–3.6	5.0–9.0	4.0–5.0	309–353
Little millet	60.0–75.0	10.0–15.0	5.0–6.0	4.0–8.0	2.5–5.0	329–341
Barnyard millet	55.0–65.0	6.0–13.0	2.0–4.0	9.5–14.0	4.0–4.5	300–310
Proso millet [Figure 6]	55.0–70.0	10.0–13.0	1.0–3.5	2.0–9.0	2.0–4.0	330–340

Table 3: Mineral composition of millets (mg/100 g edible portion, dry weight basis).

	K	Na	Mg	Ca	P	Mn	Zn	Cu	Fe
Pearl Millet	440–442	10.0–12.0	130–137	10–46	350–379	1.15–1.8	2.95–3.1	0.62–1.06	7.49–8.0
Finger Millet	408–570	7.0–11.0	110–137	240–410	240–320	5–5.5	2–2.23	0.4–4	3.9–7.5
Foxtail Millet	250–400	4.6–10	100–130	10–30	270–310	2.19–26	2.14–9	1–3.0	3.26–19
Little Millet	129–370	6–8.1	120–133	12–30	251–260	1.0–20.0	3.5–11	1.0–4.0	13–20
Proso Millet	250–320	8.2–10	117–153	20–23	230–281	0–1.81	1.4–2.4	0.83–5.8	4.0–5.2
Kodo Millet	144–170	4.6–10	130–166	10–31	215–310	1.10–2.9	0.7–1.5	1.6–5.8	0.7–3.6

within a range of 1–7% [Table 2]. Millets are the richest dietary fiber source among all other cereals.[15]

Among all millets, the finger millet contains the highest amount of potassium (K) (408–570 mg) and calcium (Ca) (240–410 mg), with a significant amount of sodium (Na) and copper (Cu) among all the other millets. Little millet is richest in iron (Fe) (13–20 mg); contains a significant amount of manganese (Mn) (1–20 mg) and zinc (Zn) (3.5–11 mg), [Table 3].[15]

Millets typically contain large quantities of essential amino acids, especially methionine and cysteine.[16] [Table 4] shows that cereals and millets also contain small amounts of amino acids, such as lysine and tryptophan.[12,14]

Table 4: Amino acids content of millets.

Amino acids (g/100g)	Foxtail millet	Proso millet	Pearl millet	Finger millet
Isoleucine	4.59	4.1	5.1	4.3
Leucine	13.60	12.2	14.1	10.8
Lysine	1.59	1.5	0.5	2.2
Methionine	3.06	2.2	1.0	2.9
Phenylalanine	6.27	5.5	7.6	6.0
Threonine	3.68	3.0	3.3	4.3
Aline	5.81	5.4	4.2	6.3
Histidine	2.11	2.1	1.7	2.3
Tryptophan	NA	0.8	1.2	NA

Health benefits of millets

Millets are a good source of phytochemicals for minor low-density lipoprotein, cancer risk, high phytochemicals, and antioxidants.[17] Epidemiological research revealed a reduced risk of cardiovascular disease and diabetes in people using finger millet in their diet.[18] Intake of foods such as millets rich in fiber decreases the risk of diabetes and slows the absorption and digestion process.[19] Barnyard millet [Figure 7] reduces blood glucose levels and serum cholesterol.[20] Intake of foods such as millets rich in fiber decreases the risk of diabetes and slows the absorption and digestion process.[19,21] Regular consumption of whole grains rich in fiber decreases cardiovascular disease.[22] Barnyard millet reduces blood glucose levels and serum cholesterol.[20] The phenolic content and fiber present in small millets and sorghum [Figure 8] help reduce esophageal cancer risk.[23]

Millets as fortifying vehicle

Fortification may be the cheapest, easiest, and best way to combat nutritional insecurity in India.[24] Finger millet flour can effectively be used as a vehicle for zinc fortification to derive additional amounts of bioaccessible zinc, with reasonably good storage stability, to combat zinc deficiency.[25] Supporting nutritional security and millet biofortification need to be done for iron and zinc.[26] The millets can be used as a fortifying vehicle to improve nutritional security in society's lower strata. It is cheaper than other staple foods and is readily available.[27] Millets can serve as a fortifying agent for many micronutrients, such as zinc, iron, calcium, and vitamins, and can be used in bakery products.[4] Consuming iron-rich millet for a regular period of 6-months helps in reversing iron deficiency.[28] Finger millet flour is a fortifying vehicle for zinc to explore more zinc from grain, which could help fight zinc deficiency.[25] Fortifying millet flours with iron

Figure 4: Proso millet grain.[9]

Figure 5: Kodo millet grain.[9]

Figure 6: Proso Millet Panicles.[9]

can be helpful in the battle against iron deficiencies. Finger millet and sorghum grains seem to fit as carriers for iron fortification.[29]

Figure 7: Baarnyard millet panicles.[9]

Figure 8: Sorghum Millet Panicles.[9]

Health needs and prospects of value-addition to millets

These days, a large population is focused on herbal and healthier food options and readily spending money to improve health conditions.[30] However, the consumption rate has dropped drastically over the years.[31] That is why a gap between the production and value-addition of millets exists; hence, international and national research bodies have taken the initiative to fill this gap between the production and utilization of millets.[32] Millets possess medicinal properties, so there is a need to process them into value-added products to align with various nutritional security programs.[33] Recently, the nutraceutical sector of the food trade is unfolding and designer foods such as nutrition bars have found their place in this competitive industry.[32] The inclusion of underutilized food sources in developing new value-added products is ingenious.[30] These days, the world is looking toward millets to use in high-end consumer products as an alternative for unhealthy snacks, which were otherwise used only in traditional ways.[1] One

such high-end consumer food is snack bars/nutrition bars/food bars.[34]

CEREAL BAR: THE FUTURE FOODS

Cereal bars are an important part of our diet and are being consumed not only as a breakfast meal but at any time during the day. Multicomponent cereal bars have a strong market capability to offer good health assistance to the public.[35] Cereal bar consumed as a replacement for morning breakfast-snacks helps mood and memory.[36] During the past few years, healthy cereal bars have achieved more prominence and success in the snacks industry, and nowadays, the sector provides a broad range of bars with various labels.[37] Commercially, available bars such as Yogabar Breakfast Protein Bar, Kellogg's Frosties Bar, Horlicks Multicereal Nutrition Bar, Mojo Bar, General Mills Nature Valley Granola Bar, RiteBite Max Protein Daily Nutrition Bar, and Muscle Blaze Protein Energy Bar are widely known to Indian customers.[38]

Cereal bars market potential

Indian food industries are focused on fulfilling the need for safe and healthy foods for consumers. This trend includes the market of convenience or functional foods by exploring local, sustainable raw materials, aimed to create a regional market that is safe, nutritious, and healthy for the environment as well.[39,40] The consumer's eating habits have changed with time; a hectic lifestyle leads to eating away from home and unhealthy snacking patterns. Nutritional bars are a perfect replacement for a regular diet for such people.[41] However, scientists/developers need to know consumers' specific requirements, especially for functional foods, to prosper in the market.[42] This business provides enormous opportunities for expansion.[43]

CURRENT STATUS OF MILLET BASED BARS AND FUTURE POTENTIAL

Various bars developed using millets in different forms throughout the period are discussed in this section. Sorghum flour-based bar was developed by which provided 4.12 mg of iron as sorghum is a rich source of iron and dietary fiber. Anemia in adolescents is rising as they mostly consume fat-rich snacks.[44] A high-energy (386.6 Kcal) and high-fiber (9%) bar were developed as a convenience food for a dietary supplement for consumers of all age groups, and enhanced protein content is observed for millet accompanied by Moringa seed.[45] Popped sorghum and sorghum-based Kissra were the primary source of fiber in the bar.[46] Two different variants were developed using foxtail millet and pearl millet [Figure 9] in other portions as a meal replacement bar and a protein bar. Millets were chosen for product development to target high-end consumers to enhance the urban population.[32] Millets were incorporated in the form of flakes in a probiotic fruit bar designed to meet health needs. Millets can also act as a raw material in the probiotic range of products with good sensory and nutritional properties.[47] For increased availability and utilization of millets as a ready-to-eat product, a cereal bar with balanced nutrients was developed. Millets were incorporated in popped pearl millet with other grains and nutraceutical value.[48] Foxtail millet [Figure 10], barnyard millet [Figure 11], and finger millet can be incorporated as flakes to develop a cereal bar rich in carbohydrates (56.3%) and energy (404 Kcal/100 g), to fulfill the nutrients need of adolescent female athletes. These bars are tested as microbiologically safe for consumption.[49] A low glycemic index (37.6) cookie bar incorporated with foxtail millet (15%) can be developed as diabetic food that may reduce the risk of obesity and *diabetes mellitus* in the Indonesian population.[34]

Figure 9: Pearl Millet Panicles.

Figure 10: Foxtail millet panicles.

A low-cost sports bar can be developed with the incorporation of a mix of four different millets (35–50% of little millet [Figure 12], sorghum [Figure 13], pearl millet, and foxtail millet [Figure 14]) and other local ingredients. A sports bar is a replacement of snacks in between meals for athletes to meet their energy needs and provided high energy (400 Kcal/100 g), carbohydrates (72.5%), and protein (13.7%).[50] Foxtail millet (20–30%) can be incorporated with cereals and legumes to produce a nutribar for nutrition supply to malnourished children. This nutribar contains a balanced percentage of all vital nutrients, that is, 40% fat, 30% carbs, 18% protein, and 5% fiber.[51] Sorghum flour can be used along with peanut butter and cocoa butter as a major ingredient to develop a protein-rich snack bar that can provide approximately 25% of protein and 9% dietary fiber. These bars can be recommended for supplementary nutrition programs across the globe, especially in developing countries like India who is spending 11,000 crores rupees, a considerable share of GDP in similar programs like Mid-Day-Meal.[52,53] Pearl millet [Figure 15] can be incorporated in the development of protein bar up to 30%, increasing the consumption rate of pearl millet as a functional food in the ready-to-eat food category.[54]

Figure 11: Barnyard millet grain.

Figure 12: Little Millet grain.

Figure 13: Sorghum Millet grain.

Figure 14: Foxtail millet grain.

Figure 15: Pearl millet grain.

In 2018, the Indian Nutritional bars market was valued at 70.43 crores. Forecasted data show that it will be worth 346.15 crores by 2024 by advancing with a compound annual growth rate of more than 30%. The meal-replacement bars market is expected to see a boom shortly. India is one of the prominent markets in the Asia Pacific region (growing fastest in the world) and China due to the large population of the countries.[55]

CONCLUSION

In times of climate change, when we need climate resilience, our forgotten foods have the potential to become foods of the future, given their adaptable ecological behavior. This review suggests that there is an urgent need to process millets to high-end value-added products to increase its consumption among youth. One such low-cost product could be a millet-based food bar to meet nutritional needs. This product is an instant food product and having a huge market potential and can address modern world issues. Global agencies such as FAO and USFDA are also working toward changing the deep-rooted perception that millets are menial to other staple crops like wheat, even after significant proof that millets are loaded with higher health aids. In this row, millets have been declared as "Nutri Cereals" in the year 2018 by the Government of India to step-up the consumption, which will help farmers get better income. However, more research and government focus are needed to highlight the nutritional values, health benefits, availability, and future prospectus of the millet and its value addition.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Kumar A, Tomer V, Kaur A, Kumar V, Gupta K. Millets: A solution to agrarian and nutritional challenges. Agric Food Secur 2018;7:1-15.
2. Rao PP, Basavaraj G. Status and Prospects of Millet Utilization in India and Global Scenario; 2015.
3. Sutton MA, van Grinsven H, Billen G, Bleeker A, Bouwman AF, Bull K, *et al*. Fifth Assessment Report of Intergovernmental Panel on Climate Change (IPCC)- Summary for Policy Makers. The European Nitrogen Assessment; 2014.
4. Chandra A, Singh AK, Mahto B. Processing and value addition of finger millet to achieve nutritional and financial security. Int J Curr Microbiol Appl Sci 2018;7:2901-10.
5. Kanjilal B, Mazumdar PG, Mukherjee M, Rahman MH. Nutritional status of children in India: Household socio-economic condition as the contextual determinant. Int J Equity Health 2010;9:19.
6. Raza A, Razzaq A, Mehmood SS, Zou X, Zhang X, Lv Y, *et al*. Impact of climate change on crops adaptation and strategies to tackle its outcome: A review. Plants (Basel, Switzerland) 2019;8:34.
7. Talwar HS, Elangovan M, Patil JV. Sorghum a Potential Crop to Adapt to Future Climate Change Scenario. Managing Intellectual Property under PVP and PGR; 2020.
8. Gupta SM, Arora S, Mirza N, Pande A, Lata C, Puranik S, *et al*. Finger millet: A "certain" crop for an "uncertain" future and a solution to food insecurity and hidden hunger under stressful environments. Front Plant Sci 2017;8:643.
9. Rao BD, Ananthan R, Hariprasanna K, Bhatt V, Rajeswari K, Sharma S, *et al*. Nutritional and Health Benefits of Nutri Cereals. Director, ICAR-Indian Institute of Millets Research, Hyderabad, 85; 2018. Available from: https://nutricereals.dac.gov.in/Publication/Pub_HealthyBenfits_Sep2018.pdf [Last accessed on 2021 Jun 23].
10. Joshi B, Shrestha R. Future Smart Food. Kathmandu, Nepal: Nepal Agricultural Research Council, Ministry of Agricultural Development; 2018. p. 161-78.
11. Rao B. Initiative of Nutritional Security through Intensive Promotion (INSIMP); 2011. Available from: https://agricoop.nic.in/sites/default/files/INSIMP.pdf [Last accessed on 2021 Jun 23].
12. Amadou I, Gounga ME, Le GW. Millets: Nutritional composition, some health benefits and processing a review. Emir J Food Agric 2013;25:501-8.
13. Bureau F. Government renames millets as Nutri Cereals. Financial Express. Available from: https://www.financialexpress.com/market/commodities/government-renames-millets-as-nutri-cereals/1140338 [Last accessed on 2020 Sep 30].
14. Devi PB, Vijayabharathi R, Sathyabama S, Malleshi NG, Priyadarisini VB. Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: A review. J Food Sci Technol 2014;51:1021-40.
15. Himanshu, Chauhan M, Sonawane SK, Arya SS. Nutritional and nutraceutical properties of millets: A review. Clin J Nutr Diet 2018;1:1-10. Available from: https://asclepiusopen.com/clinical-journal-of-nutrition-and-dietetics/volume-1-issue-1/7.pdf [Last accessed on 2021 Jun 23].
16. Obilana AB, Manyasa E. Millets. In: Pseudocereals and Less Common Cereals. Springer, Berlin: Heidelberg; 2002. p. 177-217.
17. Coulibaly A, Kouakou B, Chen J. Phytic acid in cereal grains: Structure, healthy or harmful ways to reduce phytic acid in cereal grains and their effect on nutritional quality. Am J Plant Nutr Fert Technol 2011;1:1-22.
18. Saleh AS, Zhang Q, Chen J, Shen Q. Millet grains: Nutritional quality, processing, and potential health benefits. Compr Rev Food Sci Food Saf 2013;12:281-95.
19. Dhingra D, Michael M, Rajput H, Patil RT. Dietary fibre in foods: A review. J Food Sci Technol 2012;49:255-66.
20. Ugare R, Chimmad B, Naik R, Bharati P, Itagi S. Glycemic index and significance of barnyard millet (*Echinochloa frumentacae*)

in Type II diabetics. J Food Sci Technol 2014;51:392-5.
21. Ali R, Staub H, Leveille G, Boyle P. Dietary fiber and obesity. In: Dietary Fiber in Health and Disease. Springer, Boston: MA; 1982. p. 139-49.
22. Slavin J. Whole grains and human health. Nutr Res Rev 2004;17:99-110.
23. Chen F, Cole P, Mi Z, Xing L. Corn and wheat-flour consumption and mortality from esophageal cancer in Shanxi, China. Int J Cancer 2009;53:902-6.
24. Ritu G, Gupta A. Fortification of foods with Vitamin D in India. Nutrients 2014;6:3601-23.
25. Tripathi B, Platel K. Finger millet (*Eleucine coracana*) flour as a vehicle for fortification with zinc. J Trace Elem Med Biol 2010;24:46-51.
26. Varadharaju N, Ganesan S. Effect of parboiling on de-hulling and cooking qualities of kodo and barnyard millet. In: Recent Advances in Processing, Utilization and Nutritional Impact of Small Millets. 2013 p. 66.
27. Changmei S, Dorothy J, Jaganathan D. Millet-the frugal grain. Int J Sci Res Rev 2014;3:75-90.
28. Scott SP, Murray-Kolb LE, Wenger MJ, Udipi SA, Ghugre PS, Boy E, *et al*. Cognitive performance in indian school-going adolescents is positively affected by consumption of iron-biofortified pearl millet: A 6-month randomized controlled efficacy trial. J Nutr 2018;148:1462-71.
29. Platel K. Millet flours as a vehicle for fortification with iron and zinc. In: Handbook of Food Fortification and Health: From Concepts to Public Health Applications. New York, NY: Humana Press; 2013. p. 115-23.
30. Constantin OE, Istrati DI. Functional properties of snack bars. In: Functional Foods. London: IntechOpen; 2018. p. 1-14.
31. FAOSTAT. FAOSTAT 2020. Rome: Food and Agriculture Organization; 2020. Available from: http://www.fao.org/faostat/en/#data/QC [Last accessed on 2021 Jun 25].
32. Kerenhappuch SS, Peerkhan N. Nutraceutical characterization and shelf life analysis of millet incorporated nutrition bars. Int J Res Pharm Sci 2020;11:2056-62.
33. Sarita S, Ekta S. Potential of millets: Nutrients composition and health benefits. J Sci Innov Res 2016;5:46-50.
34. Lestari LA, Huriyati E, Marsono Y. The development of low glycemic index cookie bars from foxtail millet (*Setaria italica*), arrowroot (*Maranta arundinacea*) flour, and kidney beans (*Phaseolus vulgaris*). J Food Sci Technol 2017;54:1406-13.
35. Dutcosky SD, Grossmann MV, Silva RS, Welsch AK. Combined sensory optimization of a prebiotic cereal product using multicomponent mixture experiments. Food Chem 2006;98:630-8.
36. Smith A, Wilds A. Effects of cereal bars for breakfast and mid-morning snacks on mood and memory. Int J Food Sci Nutr 2009;60 Suppl 4:63-9.
37. Padmashree A, Sharma GK, Srihari K, Bawa A. Development of shelf stable protein rich composite cereal bar. J Food Sci Technol 2012;49:335-41.
38. Tadimalla RT. Best Nutrition Bars Available In India; 2020. Available from: https://www.stylecraze.com/articles/best-nutrition-bars-available-in-india [Last accessed on 2020 Jul 17].
39. Hanus G. The influence of the trends in consumers' food behavior contributing to the formulation of marketing strategies for food companies. World Sci News 2018;112:85-95.
40. Nitzko S. Consumer requirements for food product transparency. Ernährungs Umsch Int 2019;66:198-203.
41. Rush E. Concept to sale of a healthier snack bar. Int J Food Nutr Sci 2016;3:1-4.
42. Jain S, Sharma K, Khadke M. Consumer behavior towards functional foods in India a study of market drivers and challenges. IOSR J Bus Manag 2014;2:33-40.
43. Hasler CM. The changing face of functional foods. J Am Coll Nutr 2000;19 Suppl 5:499S-506.
44. Rufaizah U. The use of sorghum (*Sorghom bicolor* L. Moench) flour in making high of dietary fiber snack bar and source of iron for adolescent girls. J Agritech 2011;35.
45. Nour AA, Mohamed AR, Adiamo OQ, Babiker EE. Changes in protein nutritional quality as affected by processing of millet supplemented with *Moringa* seed flour. J Saudi Soc Agric Sci 2018;17:275-81.
46. Ravindra MP, Sunil MD. Development and quality evaluation of puffed cereal bar. Int Jo Pure Appl Biosci 2018;6:930-6.
47. Kavitha B, Vijayalakshmi R, Yalagala PC, Illamaran M, Sugasini D. Nutritional evaluation and cell viability of formulated probiotic millet fruit bar. J Food Nutr Disord 2018;7:2.
48. Kumari R, Singh K, Kumar A, Singh R, Bhatia N. Evaluation of nutrient content in crunchy bar developed from popped pearl millet (*Pennisetum glaucum*). J AgriSearch 2019;6:150-2.
49. Vahini RV. Nutritional and microbiological assessment of nutrient enriched millet bar for adolescent female athletes. Int J Eng Sci Res 2018;8:204-8.
50. Sobana R. Quality evaluation of millet based composite sports bar. Int J Food Sci Nutr 2017;2:65-8.
51. Bukya A, Ankush SA, Nagesh GD. Characterization and optimization of cereal, legume and millet incorporated nutri-bar and its storage. Int J Sci Res 2018;7:81-3.
52. Verma S, Khetrapaul N, Verma V. Development and standardisation of protein rich sorghum based cereal bars. Int J Curr Microbiol Appl Sci 2018;7:2842-9.
53. Ministry of Education. Year Wise Outlay under Mid Day Meal Scheme. Department of School Education and Literacy, Government of India. Available from: http://mdm.nic.in/mdm_website [Last accessed on 2020 Jul 19].
54. Samuel KS, Peerkhan N. Pearl millet protein bar: Nutritional, organoleptic, textural characterization, and *in-vitro* protein and starch digestibility. J Food Sci Technol 2020;57:3467-73.
55. Market Research Future. Global Nutritional Bar Market Research; 2020.