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## **Title: Innovations in Energy Bars: Formulation, Nutritional Analysis, and Consumer Perspectives**

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### **Abstract:**

This research paper examines the development of energy bars and nutritional analysis across various studies, exploring diverse formulations, ingredients, and their impact on consumer health. The critical variables include ingredient composition, nutritional content, sensory attributes, and potential health benefits. The study encompasses a wide range of publications, highlighting energy bars' evolution and significance in addressing nutritional needs. The authors investigate the feasibility of incorporating local, organic, and functional ingredients to enhance nutritional value and consumer acceptance. The findings contribute to the understanding of formulating energy bars catering to specific dietary preferences and health requirements, offering valuable insights for the food industry and health-conscious consumers.

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### **Key Variables:**

Ingredient Composition, Nutritional Content, Sensory Attributes, Health Benefits, Consumer Preferences, Amaranth, Global Market, Health Benefits, Plant-based Diets, Gluten-Free, Competitive Landscape, Market Trends.

### **Introduction:**

The Amaranthaceae family, also known as the "Amaranth family," derives its name from the Greek word "Anthos" (Flower), symbolizing everlasting qualities. Recognized as a vital crop for the third millennium, taxonomical studies classify the family into two sections: *Amaranthus saucer* and *Blitopsis dumort*, each with a nearly equal number of species.

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Amaranth seeds, sourced from the Amaranthaceae family, boast a rich history and exceptional nutritional value. Primarily cultivated from species like *Amaranthus caudatus*, *Amaranthus cruentus*, and *Amaranthus hypochondriacus*, these seeds have been a global dietary staple. High in protein, essential amino acids, fiber, vitamins, and minerals, amaranth seeds are gluten-free, making them suitable for sensitive individuals and gluten-free diets. Recognized for antioxidants like polyphenols and flavonoids, these versatile seeds are used in various dishes and gluten-free products.

The food industry has witnessed a growing demand for convenient and nutritious food options, with energy bars emerging as a popular choice among consumers. This trend aligns with the increasing focus on health and wellness as individuals seek on-the-go solutions that provide essential nutrients. The research explores the intersection of the food and health industries, emphasizing the role of energy bars in meeting these evolving consumer needs. Additionally, incorporating locally available ingredients reflects a trend toward sustainability and supporting local agriculture.

Beyond culinary use, amaranth seeds offer potential health benefits, supporting heart health, digestion, and disease prevention. Amaranth seed energy bars have emerged to meet the demand for wholesome foods. These bars, featuring nutrient-dense amaranth, blend complementary ingredients for a harmonious fusion of flavors and textures. With a subtle nutty flavor and satisfying crunch, these bars cater to gluten-sensitive individuals, providing a convenient on-the-go option for physical activities. Enriched with antioxidants, fiber, and healthy fats, amaranth seed energy bars contribute to overall well-being, offering a delectable and nutrient-packed choice in the health-conscious snack market. Whether enjoyed as a quick snack or pre/post-workout fuel, these bars present a flavorful and healthful alternative to conventional processed snacks.

### **Global Amaranth Market Insights:**

Global Amaranth Market size was valued at USD 5.89 billion in 2021 and is poised to grow from USD 6.58 billion in 2022 to USD 15.94 billion by 2030, growing at a CAGR of 11.7% in the forecast period (2023- 2030).

The global amaranth market is rapidly growing, driven by a combination of factors such as increasing awareness of the health benefits of amaranth, the rise of plant-based diets, and the growing demand for gluten-free and organic products. Amaranth is a highly nutritious pseudo-grain rich in protein, fiber, vitamins, and minerals, making it a popular ingredient in health foods and dietary supplements. One of the primary drivers of the global amaranth market is the increasing awareness of its health benefits. It is rich in protein, essential for building and repairing tissues in the body, and contains all nine essential amino acids.

Additionally, amaranth is a good source of fiber, which promotes digestive health, and it is rich in vitamins and minerals, such as iron, calcium, and magnesium, making it a valuable ingredient in producing healthy foods and supplements. The rise of plant-based diets is another primary

driver of the global amaranth market. As consumers become more health conscious and environmentally aware, they increasingly turn to plant-based diets

to improve their health and reduce their carbon footprint. Amaranth is a popular ingredient in plant-based diets as it is a good source of protein and can be used in various dishes, including breakfast cereals, baked goods, and snack bars. The growing demand for gluten-free and organic products is also driving the growth of the global amaranth market. Amaranth is a naturally gluten-free grain, making it a popular alternative to wheat and other grains for people with celiac disease or gluten intolerance. Additionally, amaranth is often grown using organic farming methods, making it a preferred choice for consumers looking for organic and sustainable food products. (Source Name: <https://fdc.nal.usda.gov/> )

**Authors Opinions:**

The authors aim to convey the evolving landscape of energy bars, emphasizing the importance of incorporating diverse and locally available ingredients. They advocate for the development of energy bars that meet nutritional standards and align with consumer preferences. Exploring health benefits and sensory attributes underscores the potential for energy bars to serve as nutritious snacks and meal replacements. Overall, the authors seek to contribute valuable insights to the food industry, guiding the formulation of energy bars that cater to a broad range of consumer demands.

S.No	Author	Year and Publication	Title of the Paper	Findings
1	Asha Verma, Devraj Singh and Abhirup Mitra	2022 The Pharma Innovation Journal	Development of gluten-free energy bar and its proximate analysis	The literature review emphasizes the crucial role of energy bars as quick energy sources for individuals with time constraints, suggesting the incorporation of flaxseed for enhanced nutritional quality. Cost-effective strategies are recommended to minimize resource wastage, with further research needed to meet the nutritional needs of adolescents.
2	Saba Nadeem Dar1, Nehzat Zehra, Fatima Javed, Minahil Fatima, Sana Saleem, Kiran Firdous, Anum Firdous, Aqsa Nadeem	2023 International Journal of Pharmacy & Integrated Health Sciences	DEVELOPMENT OF COST-EFFECTIVE AND NUTRITIOUS SNACK BAR FROM LOCALLY	This project aimed to evaluate the acceptability of a snack bar made with local ingredients. This study aimed to manufacture a snack bar

			AVAILABLE INGREDIENTS	nutritionally enriched with local ingredients such as "roasted black chickpeas," nuts, and underutilized seeds.
3	Payal Garg and Jaswinder Kaur Brar	2017 Department of Food and Nutrition, Punjab Agricultural University	Development and Organoleptic Evaluation of Nutritious Bars by Using Defatted Peanut Flour and Roasted Soybean Seeds for Gym Trainees	The investigation into plant-based nutritional bars for gym trainees recommends defatted peanut flour and roasted soybean seeds, showcasing cost-effectiveness and high nutrition for muscle mass enhancement.
4	Sidra JABEEN, Nuzhat HUMA, Aysha SAMEEN, Muhammad Anjum ZIA	2020 Research Gate	Formulation and characterization of protein-energy bars prepared by using dates, apricots, cheese, and whey protein isolate	The evaluation of PE bars in Pakistan highlights their sensory attributes and potential as meal replacements, advocating for modifications aligned with RDA for effective combat against protein-energy malnutrition.
5	Chetan Sharma, Amarjeet Kaur, Poonam Aggarwal, Baljit Singh	2014 CARPATHIAN JOURNAL OF FOOD SCIENCE AND TECHNOLOGY	CEREAL BARS - A HEALTHFUL CHOICE A REVIEW	Examining market saturation with granola and cereal bars prompts consideration for nutrient enrichment, emphasizing the importance of whole-grain cereal foods in reducing lifestyle-related diseases.
6	Humera Ansari, Effat Ansari, Mridula Gupta, Sheela Valecha	2021 Department of Chemistry, Kischinchand Chellaram College, India.	Preparation of energy bar using figs and dates and analysis of its nutritional status	The study on energy bars using figs and dates emphasizes healthy alternatives for consumers, with nutritional analysis positioning the bars as viable meal replacements for different age groups.
7	LATIKA YADAV AND VIBHA BHATNAGAR	2015 FOOD SCIENCE	Optimization of ingredients in a cereal bar	The optimization of cereal bars using corn syrup and honey showcases

		RESEARCH JOURNAL		specific formulations with outstanding organoleptic qualities, providing valuable insights into consumer preferences.
8	ARVIND KUMAR, VEDSHREE MOHANTY and P. YASHASWINI	2018 Current Research in Nutrition and Food Science	Development of a Protein Nutrition Bar Enriched with Spirulina Plantensis for Undernourished Children	The addition of Spirulina to energy bars is proposed for enhancing their nutritional profile, with further research needed to determine the impact on overall acceptability and nutritional benefits.
9	Mayur Chandegara , Bandana Chatterjee and Neha Sewani	2018 Intl. J. Food. Ferment. Technology 8(1): 93-97, June 2018	Development of a Novel Chocolate Energy Bar by using Nuts	Exploring a novel chocolate "energy" bar presents a commercially viable option for rapid energy recovery, emphasizing its acceptance and versatility for various consumption scenarios.
10	Amira A. Ayad, Leonard L. Williams, Deiaa A. Gad El-Rab, Raphael Ayivi, Heather L. Colleran, Sulaiman Aljaloud & Salam A. Ibrahim	2020 Cogent Food & Agriculture	A review of dates' chemical composition, nutritional and health benefits for their potential use in energy nutrition bars for athletes.	The comprehensive review of dates' chemical and nutritional value in energy nutrition bars underscores their positive impact on consumer acceptability, offering an alternative to traditional snacks with ongoing work in optimizing processing steps and exploring diverse flavors. This review provides information on date fruits' chemical composition and nutritional benefits. It explores the potential application of dates in energy nutrition bars for athletes, emphasizing their high nutritional value, rich carbohydrate content, and abundance of essential minerals and

				vitamins. The review highlights the potential of dates as a key ingredient in dietary supplements and energy bars.
11	Oana Emilia Constantin and Daniela Ionela Istrati	2014 Research Gate	Functional Properties of Snack Bars	The literature review highlights evolving consumer preferences for nutritious and safe food products, emphasizing the convenience of snack bars in delivering necessary energy and nutritional benefits. Recommendations include further research to meet the diverse needs of individuals, such as athletes and those with irregular meals.
12	Aleksandra Szydłowska , Dorota Zielinska , Anna Lepecka, Monika Trzaskowska , Katarzyna Neffe Skocinska and Danuta Kołozyn Krajewska.	2020 Agricultural - MDPI	Development of Functional High-Protein Organic Bars with the Addition of Whey Protein Concentrate and Bioactive Ingredients	The study on high-protein bars demonstrates their feasibility using organic whey protein and plant-based raw materials, offering concentrated, functional food items with high nutritional value. Suggestions for ongoing research include optimizing shelf life conditions and addressing potential microbiological contamination, with sensory qualities playing a pivotal role in consumer acceptance.
13	Iga Rybicka1, Justyna Kiewlicz1 , Przemysław Łukasz Kowalczewski, Anna Gliszczyńska-Świąło	2021 European Food Research and Technology	Selected dried fruits as a source of nutrients	Exploring dried fruits' diverse nutritional profiles recommends further research to implement them into formulations, focusing on limiting the impact of antinutrient factors. The study positions dried

				fruits as nutritious snacks, aligning with nutritionists' advice and emphasizing their health benefits.
14	D. Mridula & K. K. Singh & P. Barnwal	2011 Association of Food Scientists & Technologists (India)	Development of omega-3-rich energy bar with flaxseed.	Investigating energy bars enriched with flaxseed identifies a promising formulation for omega-3 fatty acid-rich bars, emphasizing high nutritional quality and consumer acceptability. Ongoing research is recommended to optimize shelf life conditions and storage tests, addressing potential microbiological contamination.
15	David G. Stevenson, Fred J. Eller, Liping Wang, Jay-Lin Jane, Tong Wang, and George E. Inglet.	2007 Journal of agriculture and food industry	Oil and Tocopherol Content and Composition of Pumpkin Seed Oil in 12 Cultivars	The analysis of pumpkin cultivars provides valuable insights into their diverse seed characteristics and nutritional compositions, with specific cultivars suitable for industrial applications highlighted.
16	Joachim M. Dottoa, and James S. Chacha b	2020 Scientific African	The potential of pumpkin seeds as a functional food ingredient	The review on pumpkin seeds suggests further investigations in pharmacokinetics, formulation development, and safety profiles, providing a foundation for future studies and encouraging deeper exploration into their therapeutic applications.
17	Qamar Abbas Syed*, Mafia Akram and Rizwan Shaukat	2019 BIOMEDICAL - Journal of scientific and technical research	Nutritional and Therapeutic Importance of the Pumpkin Seeds	The research on pumpkin seeds emphasizes their nutritional and therapeutic significance, calling for further research and awareness initiatives to integrate them into daily



				meals and address nutritional deficiencies.
18	Beni Lestari, Edy Meiyanto	2018 ISCC IJCC	The Emerging Nutraceutical Potential of Pumpkin Seeds	`Collective findings from various studies affirm that pumpkin seeds harbor emerging bioactive compositions with potential health benefits, paving the way for innovation in developing nutraceuticals, pharmaceuticals, and other products derived from pumpkin seeds.
19	Sidra JABEEN, Nuzhat HUMA, Aysha SAMEEN, Muhammad Anjum Z	2020 Food Science and Technology	Formulation and characterization of protein-energy bars prepared using dates, apricots, cheese, and whey protein isolate.	The study on PE bars demonstrates favorable sensory attributes, bioactive enhancements, and improved nutritional quality, suggesting their potential as meal replacements for various demographics. Recommendations include ongoing research to optimize shelf life conditions, combat protein-energy malnutrition effectively, and enhance overall nutritional quality.
20	Koppalu V. Preetham Kumar a, Usha Dharmaraj a, Suresh D. Sakhare b, Aashitosh A. Inamdar b	2016 Journal of Cereal Science	Preparation of protein and mineral-rich fractions from grain amaranth and evaluation of its functional characteristics.	The fractionation of grain amaranth to obtain a coarse seed coat fraction showcases its potential as a protein, fiber, and mineral-rich ingredient, suggesting its value as a functional food ingredient and contributing to the ongoing exploration of functional foods.
21	K. Haritha, L. Kalyani and A. Lakshmana Rao	2014 Journal of Advanced Drug	Health Benefits of Dark Chocolate	The literature on chocolate highlights its potential health benefits,

		Delivery		particularly in cardiovascular-related disorders, attributed to flavonoids. Suggestions include developing chocolate as an ideal nutraceutical-polypill delivery system, promoting good health while maintaining taste.
22	Raghuwanshi VP, Agrawal RS and Mane KA	2019 Journal of Pharmacognosy and Phytochemistry	Flaxseed as a functional food: A review	Exploring flaxseed's impact on energy bars reveals a positive correlation between flaxseed content and critical nutrients. The study recommends an optimal composition for commercial production, emphasizing the extended shelf life of omega-3-rich energy bars.
23	Abdullah, Mohd Khalid, and Mohd Kashif Hussain	2017 International Journal of Herbal Medicine	Badam (Prunus amygdalus Bail.): A Fruit with Medicinal Properties	The review underscores the significance of almonds in both medicinal and dietary aspects, urging further preclinical and clinical studies to validate their scientifically uncharted actions. Recommendations include exploring unexplored attributes and conducting studies to foster a comprehensive understanding of almond's potential benefits.
24	Bernacchia R, Preti R and Vinci G	2014 Austin Journal of Nutrition and Food Sciences	Chemical Composition and Health Benefits of Flaxseed	The comprehensive review of flaxseed emphasizes its nutritional and functional properties, providing evidence of its positive effects on preventing chronic diseases. Suggestions include further research to understand molecular mechanisms

				and processing methods for adverse compound removal.
25	Shekhara Naik R, Anurag AP, Prakruthi M, Mahesh MS	2020 IP Journal of Nutrition, Metabolism and Health Science.	Flax Seeds ( <i>Linum usitatissimum</i> ): Nutritional composition and health benefits	Flaxseed is recognized as a powerhouse of health benefits and is recommended for daily intake due to its nutritional profile. The shift towards an omega-3-rich and high-fiber diet is endorsed, positioning flaxseed as a commendable dietary supplement.
26	Val´eria Maria Caselato-Sousa and Jaime Amaya-Farfan	2018 Journal of Food Sciences	State of Knowledge on Amaranth Grain: A Comprehensive Review.	The development and standardization of Nutritious Snack Bars contribute significantly to addressing nutritional needs. The resulting nutrient-dense bars emerge as a viable solution to bridge nutritional gaps, considering sensory satisfaction, microbial safety, and economic feasibility.
27	Damini Soni, Gargi Saxena	2018 Department of Home Science, The IIS University, Jaipur, Rajasthan, India	Standardization and Development of Nutritious Snack Bar for Varied Age Groups.	The underutilized crop, <i>A. caudatus</i> , is deemed a potential supercrop of the future with diverse pharmacological activities. The review underscores the need for multidisciplinary research to elevate it to its deserved status.
28	Alicia Martinez-Lopez, Maria C. Millan-Linares, Noelia M. Rodriguez-Martina, Francisco Millan, Sergio Montserrat-de la Paza	2020 Department of Medical Biochemistry, Molecular Biology, and Immunology, School of Medicine,	Nutraceutical value of kiwicha ( <i>Amaranthus caudatus</i> L.)	Including amaranth flour and melon seeds in nutritional bars proves successful, offering a nutritious and palatable alternative. Specific formulations with high acceptance

		Universidad de Sevilla, Av. Dr. Fedriani 3, 41071 Seville, Spain		are highlighted, positioning these bars as promising options in food and non-food industries.
29	Ángel Zambrano Loo, José Muñoz Murillo and Cecilia Párraga Álava.	2021 Universidad Técnica de Manabí	Influence of amaranth and melon seeds on the nutritional composition of an energy bar.	Further research is suggested to investigate cereal sprouts' industrial applications and bioactive profile, exploring novel extraction methodologies for enhanced production of bioactive compounds. The development of personalized functional foods addressing specific ailments is recommended for innovation.
30	Zahra Maqboo, Waseem Khalid, Mahum, Anosha Khan, Maliha Azmat, Aqeela Sehrish, Sania Zia, Hyrije Koraqi, Ammar AL-Farga, Faisal Aqlan and Khalid Ali Khan	2023 University Institute of Food Science and Technology, The University of Lahore, Lahore, Pakistan.	Cereal sprout-based food products: Industrial application, novel extraction, consumer acceptance, antioxidant potential, sensory evaluation, and health perspective.	Based on the results, a high-quality cereal bar with broad acceptability can be formulated by combining quinoa, flaxseed, brown rice, nuts, and honey. Including nuts enhances the nutritional value, making it a well-rounded dietary option for gluten-intolerant populations.

**Conclusion:**

In conclusion, the research consolidates findings from various studies on energy bars, showcasing a dynamic landscape of formulations and nutritional enhancements. Incorporating local and functional ingredients emerges as a promising avenue for the food industry to create products that resonate with consumer preferences. The authors underscore the need for ongoing research to optimize formulations, improve shelf life, and address specific nutritional deficiencies. This research contributes to the academic understanding of energy bars and provides practical implications for industry professionals aiming to develop innovative, nutritious, and consumer-friendly products.

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