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From Treat to Nutrition: A Review of Gummy Candies as a Healthy Food Alternative to Develop Micro-Credential Training for Community-Based Entrepreneurship

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Abstract This research aimed to review international literature on gummy candies as a healthier food alternative to design micro-credential training targeted towards community-based entrepreneurship. This review adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. The Scopus, PubMed, and Emerald databases were searched for peer-reviewed papers published from 2000 to 2024 using three main search terms: "herbal gummy candy," "gummy candy for health," and "gummy candy supplement." A total of 20 out of 79 eligible studies were selected for analysis. We developed research questions related to the widely researched categories of gummy candies as a healthy food alternative according to their nutrient composition and related health benefits. The included studies in the Systematic Literature Review (SLR) assessed the following data and components: overall data and research design, which included authorship, publication year, sample characteristics, and research category; research parameters, including factors and variables; and overall findings, including results and recommendations. This SLR discusses the prospect of enriched gummy candies as a healthy food alternative by synthesizing information on their nutritional profiles and related health benefits. The analysis brings forth the potential for improving the formulation of gummies by adding bioactive compounds such as probiotics, prebiotics, antioxidants, plant-derived gelling agents, and sugar substitutes. It also identifies their role in gut health, blood sugar regulation, weight control, and antioxidant activity. The emphasis of the research is on natural colorants, flavorings, and sustainable production practices, which puts gummies in a good position to meet the different dietary trends of vegan and sugar-free diets. Similarly, innovative encapsulation techniques provide better stability and bioavailability of functional ingredients, thus easily paving the way for continued adoption in the manufacturing of gummies as healthy food. This SLR provides valuable insights for manufacturers, healthcare

practitioners, and consumers, emphasizing the ability of gummies to promote healthier eating habits while meeting specific nutritional needs in an easy and enjoyable way.

Keywords Healthy Candy, Alternative, Ingredients, Gummies, Entrepreneur

1. Introduction

Gummy confections, considered a source of pleasure and indulgence in the past, have undergone tremendous changes in recent years. These gummies have evolved far beyond their role as simple sugary treats; they now represent an efficient way of delivering key nutrients like vitamins, minerals, probiotics, and many other bioactive compounds [1]. This innovation has seen significant uptake as an alternative to traditional dietary supplements, particularly by those seeking a tasty and easy way to meet their nutritional requirements [2]. Furthermore, increased interest in functional gummies reflects a broader consumer trend in tastes and preferences toward health and well-being. More accessible in form than traditional tablets or capsules, gummies alleviate "pill fatigue" while simultaneously delivering a sensory experience with flavor and texture. Accordingly, these advantages make gummies desirable for adults and children who would otherwise avoid taking supplements [3]. Nonetheless, there are many concerns over the health consequences of taking gummies. In addition, many products feature high sugar levels, chemical additives, and high-calorie levels, all of which make one wonder whether this is a healthy diet alternative. Note that excessive consumption, most especially among the younger population, has hindered their capacity to adhere to a well-rounded dietary system. The current systematic study explores the potential of gummy candies as a practicable nutritional food source. The study will critically analyze gummies' nutritional composition and health benefits to determine whether they can transcend from being just an indulgence to becoming a full-fledged part of a health-promoting lifestyle. The findings will benefit understanding their significance among current dietetic trends and impact industrial developments accordingly.

Micro-credentials are short, focused programs of study or certifications that provide industry-oriented skills. Provided by universities, organizations, and companies, many of these programs now focus on current leading edges like digital entrepreneurship and Information and Communication Technologies (ICTs) [4]. Within the twenty-first-century context, they have increasingly become perceived as crucial to rapidly re-skill the workforce to adapt it to possible careers [5]. On the other hand, Vivarelli [6] asserted that entrepreneurship can help develop the economy and bring about innovation. However, the benefits may not apply universally to all countries. Hence, his study suggested an approach to evaluating entrepreneurial ventures in developing countries focusing on community participation and sustainability instead of just efficiency. Concurrently, Eager and Cook [7] analyzed the design and implementation of an entrepreneurship micro-credential as part of a practice-based engineering education program. This curriculum was developed in consultation with industry partners who highlighted the need for innovation, creativity, and proactive thinking. The micro-credential is designed to support students in understanding how products and services can meet consumer expectations and, at the same time, identify opportunities for improvement that could drive business growth. Moreover, micro-credentials have emerged as a significant subject of investigation, given the growing recognition of their influence on social and economic progress, especially in promoting recovery from the COVID-19 pandemic via innovation [8]. Such credentials offer individuals numerous opportunities to enhance their skills, acquire new competencies, and participate in lifelong learning, which has become increasingly essential in the contemporary evolving job market.

Community-based entrepreneurship is fundamental in the restoration of ecosystems and the management of natural resources locally. Shahidullah and Haque [9] noted that in partnerships between Non-Governmental Organizations (NGOs) and Community-Based Organizations (CBOs), CBOs are likely to emerge as social entrepreneurs who generate funds through social innovation. For instance, the CBOs in Bangladesh applied entrepreneurial capability to improve the management of natural resources, overcome social hurdles, and foster community learning. Although community enterprises play a significant role in fostering local development, further investigation is necessary to better understand their challenges and the determinants that affect their sustainability [10]. Additionally, considerable uncertainty exists within the scholarly literature concerning the definition of community-based entrepreneurship and the motivations behind it. Thus, recognizing these essential factors is vital for formulating effective programs. Hassan et al. [11] argued that community entrepreneurship is influenced by various internal and external forces. Programs tackling social, physical, and environmental issues, usually undertaken by local and rural development organizations, hold promise. Hence, additional research in this line needs to be pursued to strengthen the base and increase the sustainability of community entrepreneurship. This systematic review evaluates gummy candies' potential as a healthy food alternative by examining their nutritional content and health advantages to design micro-credential training targeted towards community-based entrepreneurship.

2. Literature Review

A Systematic Literature Review (SLR) is a process of research that is comprehensive and organized in the analysis and synthesis of available research [12,13]. This rigorous process involves discovering, analyzing, and summarizing relevant articles, thus developing an overall understanding of the knowledge landscape in some topic. The overall purpose of a SLR is to collate all relevant evidence required to answer the research question effectively. In particular, the starting point for a SLR is developing specific research questions or objectives, which act as guiding principles throughout the process [14]. These underlying questions help in developing inclusion and exclusion criteria that are used in the selection of pertinent research. An effective search strategy is crucial in systematically searching various scholarly databases to identify relevant studies [15–17]. In general, a SLR is characterized by its clearly defined and transparent method of data analysis that ensures the reliability of the results [12,13]. Every process step, from the very beginning to the final article selection, is documented in detail. Such transparency lends credibility to the SLR and helps other researchers replicate it, thus making result verification easier [15,18–20].

Researchers can create a high-quality synthesis based on solid data by employing a systematic and critical evaluation method [14]. Critical appraisal is a vital component of SLR, which entails conducting a thorough investigation to determine the quality and relevance of each selected study. In addition, synthesizing information from selected studies is crucial in the last step of SLR. This strategy comprises acquiring, arranging, and carefully assessing data in order to reach general conclusions and identify trends or gaps in the existing literature [21,22]. Synthesis methods can take various forms, depending on the type of data and study objectives, including narrative summary, theme analysis, and quantitative meta-analysis. SLR is an exceptionally beneficial technique since it offers a full and unbiased examination of the available information. This viewpoint allows researchers, practitioners, and policymakers to make educated judgements based on the integrated findings of various studies [15,20]. Moreover, SLR promotes knowledge generation in certain domains while highlighting gaps that require further inquiry [12,23]. Its methodological clarity and rigor make it a valuable tool for encouraging evidence-based practice and making sound judgements in a number of settings.

3. Methodology

A SLR will be conducted to determine the nutritional composition and health benefits of gummy candy as healthy food. The three primary electronic databases for the literature search will be Scopus, PubMed, and Emerald. These databases were selected since they provide in-depth coverage of health, nutrition, and food science topics important to our research. The search will use various phrases, including (a) herbal gummy candy, (b) gummy candy for health, and (c) gummy candy supplement. These phrases were selected to cover a wide range of relevant studies, from those investigating the nutritional composition and functional properties of herbal or fortified gummy candies to those examining their usefulness as dietary supplements. Furthermore, to ensure that current research and emerging trends are included, the search will be restricted to articles published between 2000 and the present. Studies that examine the health benefits of gummy candies, particularly those made with herbal or functional elements like vitamins, minerals, or probiotics, and seek to enhance specific health outcomes, will be included. In addition, to ensure quality and relevance, only peer-reviewed studies, clinical trials, and systematic reviews will be considered. Note that articles that focus solely on traditional candy gummies with no health-related component will be excluded. Accordingly, the selected articles will be evaluated for eligibility, and relevant information about gummy candies' nutritional content and health claims will be extracted for synthesis.

3.1. Eligibility Criteria

Studies that qualify for inclusion in this systematic review must meet certain criteria. To begin, only peer-reviewed papers will be accepted, including clinical trials, Randomized Controlled Trials (RCTs), systematic reviews, observational studies, and cohort studies. These studies must focus on gummy candies promoted as health supplements, particularly those that contain functional ingredients like vitamins, minerals, probiotics, or herbal extracts and are only written in English. Moreover, the emphasis should be on gummies that promote immunity, improve digestive health, or correct nutritional imbalances. Studies that examine consumer behaviour or market trends for health-conscious gummy products will also be evaluated, as they provide useful insights into the growing demand for these functional foods. Regarding demography, research will encompass both adults and children who consume health-promoting gummy candies, focusing on studies that investigate the impact of gummy supplements on health outcomes. However, studies emphasizing primarily marketing strategies or customer preferences without examining the products' real benefits will be disregarded. At the same time, studies on conventional gummy candy that lack functional health benefits or bioactive substances will be avoided. Furthermore, case studies, non-peer-reviewed articles, and opinion pieces will be rejected. Research that does not directly address the health consequences of gummy food, such as studies focused solely on gummy marketing or enjoyment, will also be omitted. Further details regarding the data in this section are shown in the Table 1.

Table 1. Overview of articles from selected data based

Database	Keywords						Total
	Herbal Gummy Candy		Gummy Candy for Health		Gummy Candy Supplements		
	Accepted	Rejected*	Accepted	Rejected*	Accepted	Rejected*	
Scopus	1	0	2	2	0	0	5
PubMed	2	0	14	24	3	3	46
Emerald Insight	0	2	1	17	0	8	28
Total	**3**	**2**	**17**	**43**	**3**	**11**	**79**

Rejected*= Reject articles if there was any duplication in the same database (appear more than 1 time in any keywords stated) and non-relevant to the research.

The systematic review began with a preliminary search using a few crucial terms. The search was broadened to include the year of publication, population, article kind, and journal source of publications. The search yielded 80 documents related to the key terms. Only 79 of the papers were released between 2000 and 2024. The papers were reviewed based on their titles and abstracts. Five articles were selected based on the composition of the herbal gummy candy. Furthermore, 60 publications focused on gummy candy for health, while 14 papers discussed gummy candy as a supplement. Accordingly, out of 79 articles, only 20 related articles were discussed in this study. Figure 1 and Table 2 explain the article selection process used in this study.

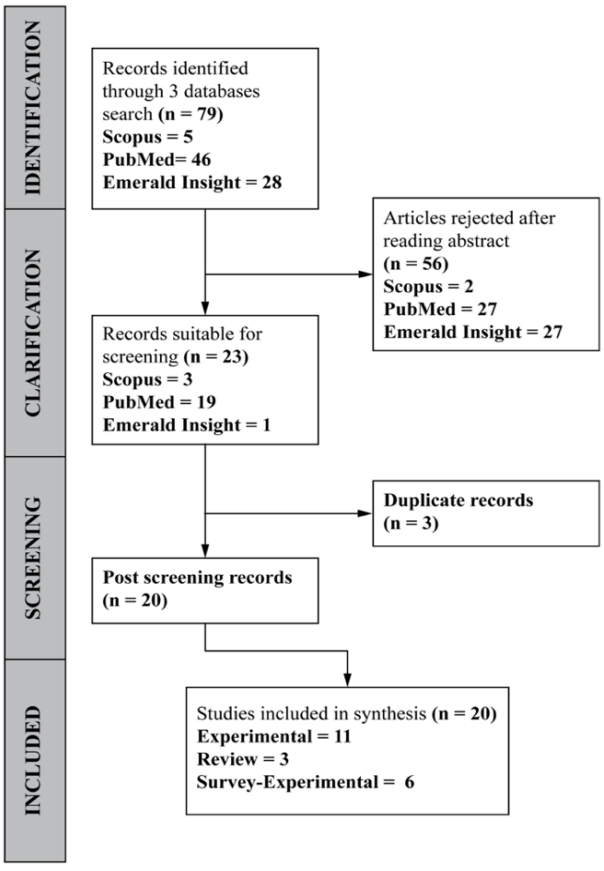

Figure 1. PRISM of systematic review process adapted from Czeczotko et al. [42]

Table 2. Duplicates*= Total number of accepted duplicate articles (same titles or DOI or abstract) across all the databases

Total Articles (A)	**79**
Total Article Rejected (B)	56
Total Article Accepted (A-B), (C)	23
Total of Duplicates* (D)	3
Final Total - After Filter (C-D)	20

Herbal gummy candy, gummy candy for health, and gummy candy supplement are all terms used to describe a developing trend combining health advantages with pleasurable, convenient gummies. Herbal gummy candy is defined as sweets infused with natural herbal components like echinacea, ginseng, or turmeric, linked to potential health advantages such as increased immunity or reduced stress. These appeal to health-conscious customers who want natural cures but dislike traditional herbal formulations. On the other hand, gummy candy for health is a broader category that includes gummies intended to help with immune support, digestive health, beauty advantages, and weight control. These gummy candies may contain vitamins, probiotics, or other beneficial components that promote general wellness in a tasty and easy-to-eat form. Finally, gummy candy supplements are marketed as nutritional supplements that deliver essential nutrients such as vitamins, minerals, and specific components in the form of gummy candies. They cater to customers who want a more appealing and simpler alternative to pills or powders, particularly those who have trouble taking traditional supplements. Overall, these products appeal to a diverse group of consumers searching for an easy, pleasurable approach to enhancing their health, focusing on natural and organic ingredients, making them a popular option in the wellness industry.

4. Findings of Literature Review

The figure below displays all the information from the selected sources on gummy candies as a healthy food alternative. The year of publication, study setting, participants, and primary findings of each literature are all clearly stated.

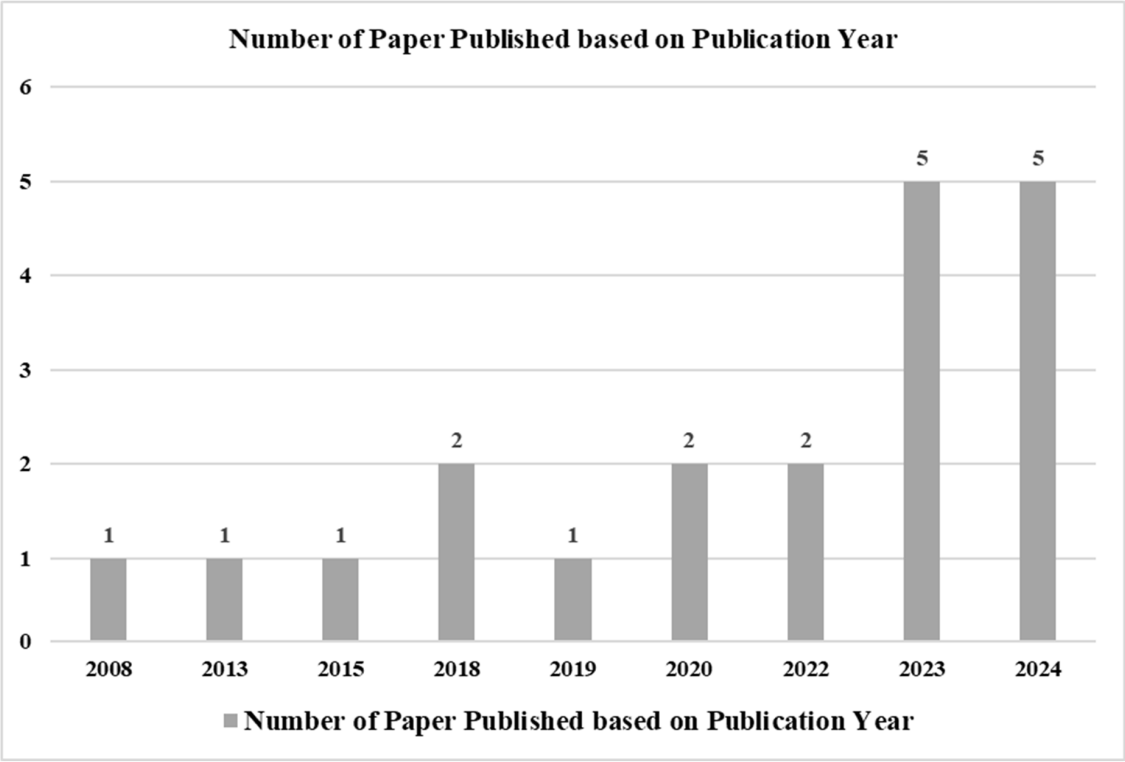

Figure 2. Paper published based on publication year

A literature review on gummy candies as a healthy food alternative uncovers noteworthy trends, including increased academic interest and ongoing efforts to develop products with improved nutritional content. This study aligns with the systematic review's objectives, which are to examine the nutritional composition and associated health benefits of gummy sweets in order to determine their potential as a healthy diet choice. Figure 2 shows the result based on the year of publication of research. The results reveal a clear upward trend in the number of gummy candy research studies completed throughout the year. For starters, only one study was published in 2008, 2013, and 2015, demonstrating that research into gummy candy as a healthy alternative is still in its infancy. However, progress started in 2018 by publishing two studies, followed by another in 2019. In 2020, there were two more publications. The most significant increase occurred in recent years, with two publications in 2022 and five in 2023 and 2024, respectively. This increase reflects researchers' growing interest and a larger recognition of gummies' ability to promote healthier eating habits. Recent studies have demonstrated considerable success in reformulating gummy sweets to increase their nutritional profile while minimizing harmful ingredients.

For example, a study from Stępień et al. [1] published in 2023 investigated algae-derived polysaccharide Furcellaran (FUR) can be employed as a gel-forming agent to produce vegan, sugar-free gummy jellies with improved texture, antioxidant activity, and mechanical properties. This makes it a promising alternative to gelatin-based products and promotes environmentally friendly packaging. This innovation stands out since it solves client concerns about sugar consumption while still providing a delightful gastronomic experience. A further significant study from Rawat et al. [24] focused on the creation of plant-based gummies with low-sucrose alternatives. Using natural gelling agents like guar gum, the researchers improved the texture and sensory acceptability of this healthier option. These findings are consistent with the systematic review's objectives, suggesting that it is possible to make appealing gummy candies while still addressing the needs of health-conscious customers.

In addition, a 2023 study from Bartkiene et al. [25] investigated the impact of using sugar replacements like xylitol and agave syrup in gummy candy formulations. The study reported that xylitol improves glucose tolerance and also provides more health benefits than traditional sweeteners. This study also supported the premise that gummy candies can be adjusted to provide health benefits while remaining appealing. To summarize, the rising amount of research on gummy candies as healthy food options stresses the significance of undertaking rigorous evaluations to determine their nutritional worth and health benefits. Furthermore, the increase in publications in recent years reflects a better understanding of how gummy candies can be transformed into functional foods that meet modern nutritional needs. As researchers continue to innovate in using natural ingredients and better formulations, gummy candies can become a more popular healthy snack option, meeting the needs of consumers who

value taste and nutrition. This growing research interest demonstrates the ability of gummy candies to change eating patterns and signals a shift in consumer tastes toward healthier food.

Figures 3 and 4 illustrate the research methods and significant elements used in the publications evaluated, demonstrating a diverse approach to evaluating gummy candies as a potential healthy diet option. Experimental approaches were the most typically utilized, accounting for 11 studies, demonstrating a strong preference for controlled testing and direct observations. Accordingly, six studies used survey-experimental methodologies, which combined participant feedback with experimental data to create a mixed-methods approach. Furthermore, three studies employed a review methodology to consolidate and synthesize existing research in this area. Figures 3 and 4 display the various research methods used to evaluate gummy sweets as potential healthy dietary alternatives. This study aligns with the systematic goal of assessing the nutritional value and health benefits. The use of an experimental technique in 11 studies indicates a significant emphasis on controlled trials and direct observation, which are crucial for ensuring that the data obtained are valid and reliable. This thorough research process is crucial for obtaining evidence-based conclusions about the acceptability of gummy candies as a healthier dietary option.

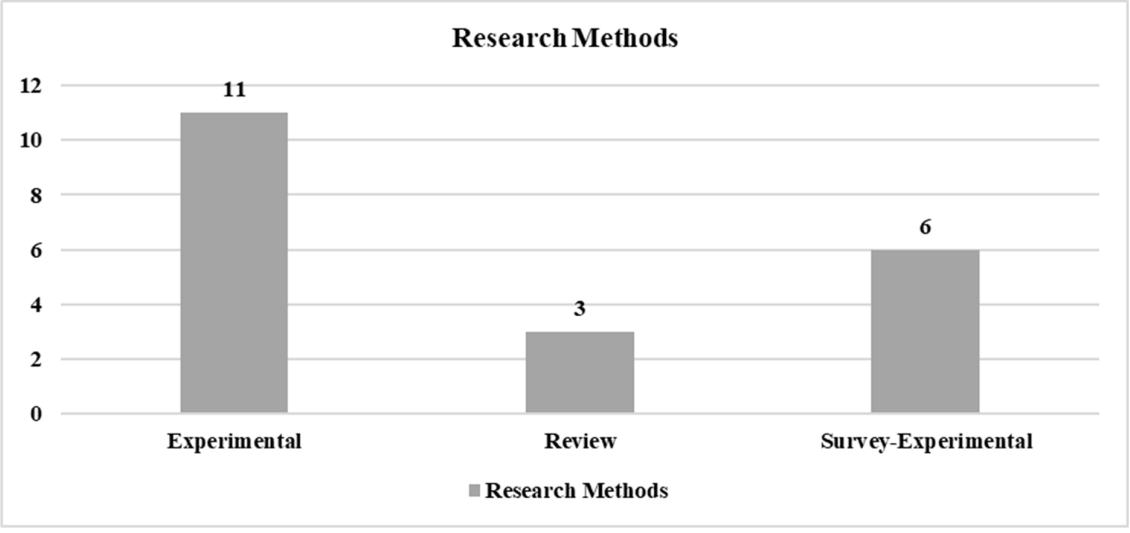

Figure 3. Research method

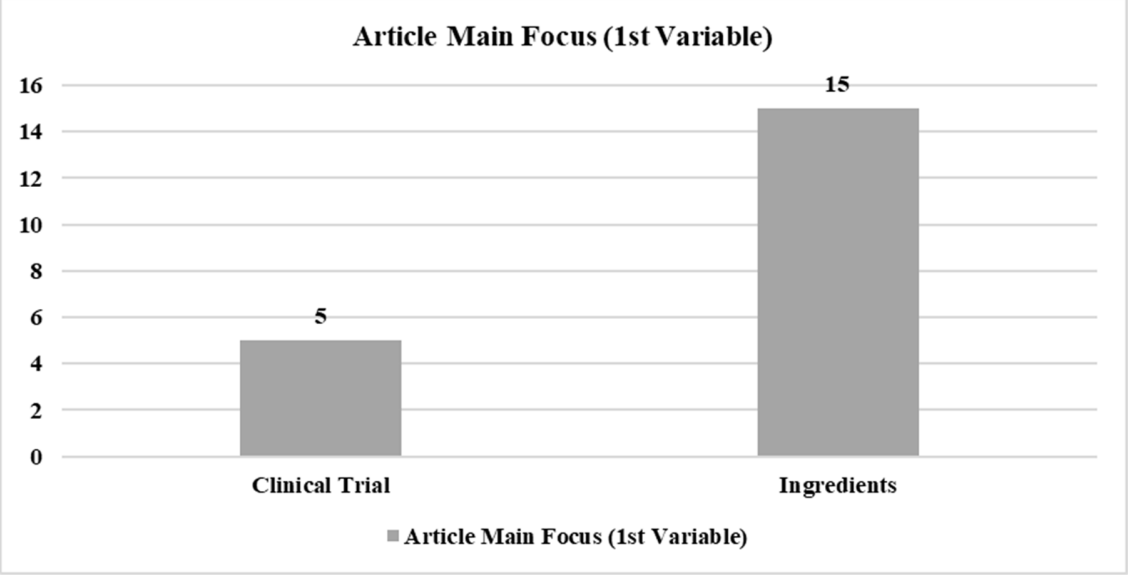

Figure 4. Main variables

In addition to the experimental study, the utilization of six survey-experimental approaches demonstrates a desire to collect user feedback using empirical data. This analytical technique provides a more in-depth insight into customer views of gummy candies, which is useful for product development and marketing initiatives aimed at healthier alternatives. Furthermore, three research that employs the role-review method integrate prior information, resulting in a more comprehensive framework for understanding nutritional content and health benefits discovered in experimental trials. In addition, the use of multiple methodologies highlighted the primary purpose of this systematic review, which was to evaluate the potential of gummy candy as a healthier nutritional choice. This study emphasizes the nutritional properties of healthier formulations, such as lower sugar content and enhanced antioxidant capacities, to provide a more comprehensive evaluation. For example, studies suggest innovative formulations, including natural ingredients or sugar substitutes, can significantly reduce calorie content while enhancing health benefits such as antioxidant capacity. These findings are consistent with the current consumer trend of valuing functional meals that promote health while remaining tasty. The use of varied research methods in the reviewed publications will help to reinforce the overall conclusions of this systematic review. This review, which synthesizes data from experimental studies, consumer surveys, and existing literature sources, can contribute to a better understanding of the role of gummy candy as a feasible healthy food alternative, guiding future research and product development in this area.

The studies also investigate various secondary variables in Figure 5, providing a broader perspective on the research topic. Notably, health was the most common variable, appearing in 12 studies focusing on analyzing gummy sweets for their potential health benefits. In particular, three studies examined the formula, highlighting the significance of improving the product's content and design. Meanwhile, two independent studies explored chemical and development variables, indicating an interest in understanding the chemical properties and processes involved in producing gummy sweets. In addition, one study focused on improvement, suggesting efforts to improve existing formulations or processes. These secondary variables demonstrate a complex strategy for promoting gummy sweets as a healthy nutritional option. Findings on secondary variables in gummy candy studies provide a comprehensive picture of their potential as healthy dietary alternatives. Health was the most researched variable, with 12 papers highlighting the necessity of studying gummies for health benefits. This is in line with the purpose of the systematic review of determining the nutritional content and health advantages of gummy sweets. Hence, by focusing on health outcomes, researchers can uncover specific benefits of certain formulas, such as decreased sugar levels or functional additives like prebiotics and antioxidants.

In addition to health concerns, three studies on gummy candy formulations highlight the significance of ingredient selection and recipe development in increasing the nutritional content of these products. Innovations such as incorporating natural sweeteners like xylitol or complementing gummy candies with bioactive substances like antioxidants or probiotics offer opportunities to improve their health appeal. Meanwhile, for community-based businesses, this study highlights the importance of connecting product design to consumer demand for healthier choices. At the same time, micro-credential training can offer organizations an understanding of unique formulation techniques, allowing them to create health-conscious products that cater to specific dietary choices and consumer trends.

Furthermore, the two studies on gummy sweets' chemical properties and growth process provide valuable insights into the mechanisms that drive product development. Understanding ingredient chemical interactions, such as the effects of different sweeteners on the glycaemic index or the digestibility of gummy candies, is critical for developing products tailored to consumers with specific dietary needs, such as diabetics or those searching for low-calorie alternatives. This information is crucial for community-based businesses that want to differentiate their products by addressing unique health issues. Correspondingly, entrepreneurs can make their meals more healthful and appealing by incorporating this knowledge into training programs.

Furthermore, one study focuses on the industry's commitment to continuously improving gummy candy recipes and manufacturing procedures. This proactive strategy highlights the significance of adapting to changing health trends and consumer preferences. For community-based entrepreneurs, this emphasizes the significance of ongoing innovation and market responsiveness. Meanwhile, training programs may focus on iterative product development methods, allowing entrepreneurs to improve their offerings and remain competitive. To summarize, these studies provide a good foundation for providing micro-credential training to empower community-based enterprises. The training, which emphasizes formulation innovations, chemical properties, and continual improvement, can equip entrepreneurs with the skills and knowledge needed to create gummy candies that meet health-conscious customers' expectations. Moreover, this strategy supports the development of healthier food alternatives and fosters long-term and innovative entrepreneurship in the health-conscious food industry. Figure 6 summarizes the overall discussion in this section.

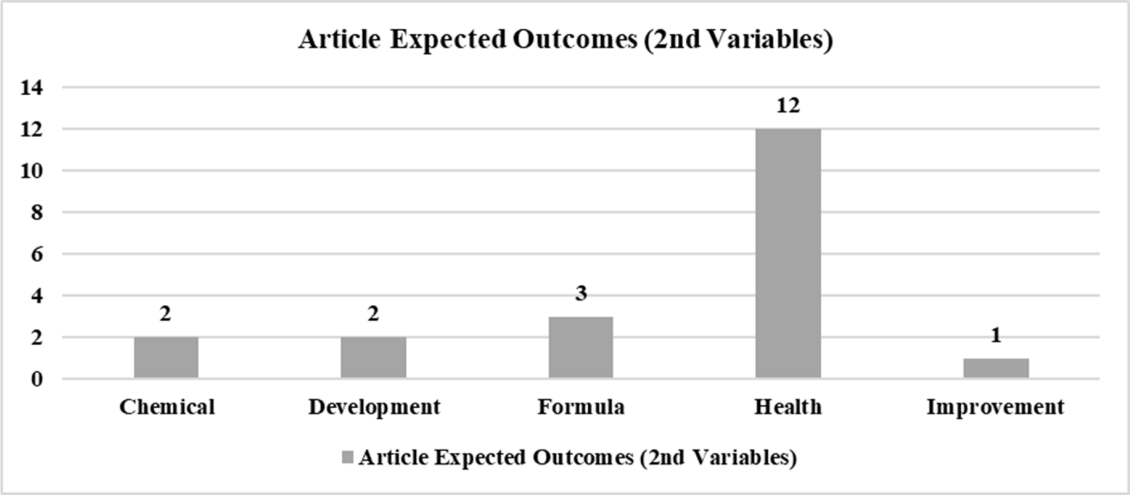

Figure 5. Expected outcomes (2nd variable)

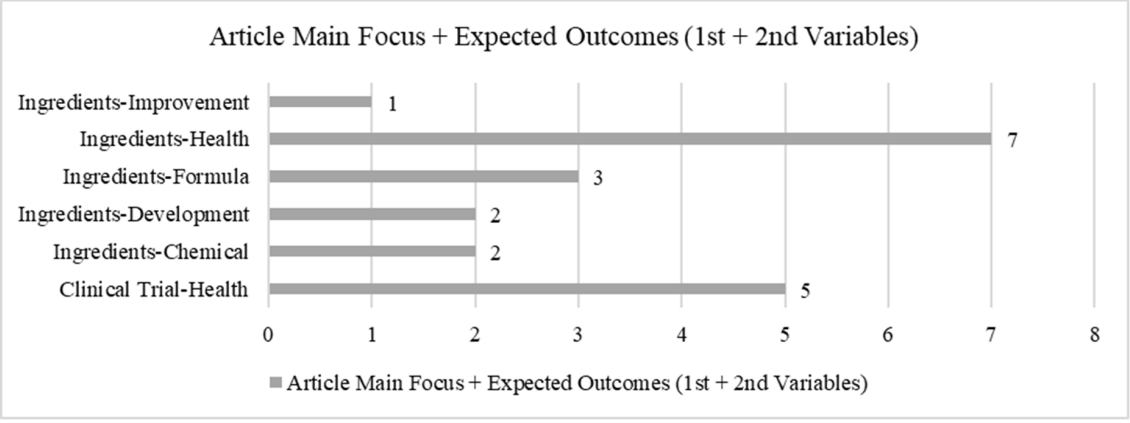

Figure 6. The main focus and expected outcomes

The data from the publications provided in Figure 7 is a comprehensive picture of the prospect of developing gummy candies as a healthy dietary option, which is consistent with the systematic review's goal of evaluating their nutritional content and health advantages. Most of the studies, five in all, are clinical trials designed to validate wellness assertions through controlled medical examinations. This study is crucial for confirming the health benefits of gummy candies, such as increased immune function and better digestion. Furthermore, this information is vital for community-based entrepreneurs to guarantee that their products have been scientifically validated, which is essential for building confidence in the health-conscious consumer. In addition, seven other studies examined the relationship between ingredients and health, specifically how individual components like vitamins and minerals contribute to general health. This knowledge helps entrepreneurs select the ideal ingredients for manufacturing health-conscious gummy sweets, enabling them to meet the growing consumer demand for functional meals. Three studies explored the interactions of components and formulations to improve the composition of gummy candies while balancing health benefits, flavor, and texture. This research is necessary for developing appealing products with health benefits essential for consumer acquisition. At the same time, two studies investigated the chemical properties of chemicals and their impact on product development, offering insights into how to keep health benefits during production.

The scientific data help to ensure the stability and nutritional purity of the completed product, which is critical for companies aiming to produce high-quality gummy candy. Finally, one study sought to improve existing formulations and manufacturing procedures, which are critical for future innovation and product improvement. This knowledge can be utilized to improve gummy candy recipes and manufacturing methods, resulting in both health benefits and consumer appeal. These studies, when combined, provide a solid foundation for producing micro-credential training for community-based entrepreneurs, equipping them with the information and resources required to make, market, and enhance healthier gummy sweets. This ideally matched with the systematic review's goal of fostering the development of healthy food options in the food industry using evidence-based techniques.

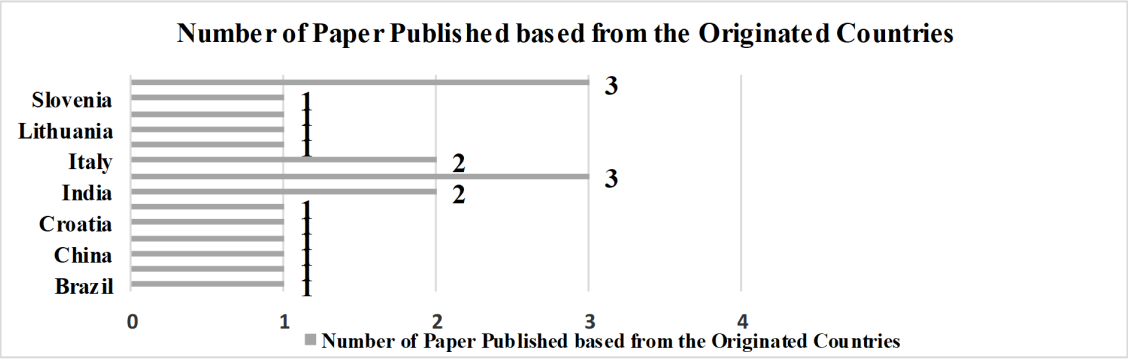

Figure 7. Paper published based on originated countries

The SLR offers valuable insights into the global research landscape for gummy candies as a healthy dietary option. The research spans several geographical locations, including South America, Asia, Europe, Africa, and North America, with notable contributions from Brazil, Chile, China, and the United States. Despite this regional variation, the examination reveals a significant gap in the global literature, as research on gummy candy is limited outside these regions. This conclusion underlines the need for more research on the feasibility, cultural acceptance, and overall potential of gummy candies as a health-conscious dietary alternative. Furthermore, this study gap has clear consequences for the systematic review's goal, which is to assess the nutritional composition and health advantages of gummy sweets in order to develop micro-credential training for community-based enterprises. Hence, understanding cultural and regional culinary tastes is critical for community entrepreneurs looking to create offerings that will appeal to local clients. According to limited studies, the health benefits of gummy candies may go unnoticed in regions with diverse dietary patterns and health objectives, such as Africa, Southeast Asia, and the Middle East. Entrepreneurs who fill this need with extensive research may gain insights into tailoring gummy sweets to regional health needs and preferences. For example, utilizing regionally sourced foods with documented health benefits, such as moringa in Africa or turmeric in South Asia, can boost cultural resonance while simultaneously improving health. These findings can be included in micro-credential training, giving entrepreneurs the knowledge they need to connect product development to regional demand, resulting in innovative products that combine health benefits with cultural acceptance.

Furthermore, the study highlights the importance of modifying gummy candy formulas to meet the nutritional and health demands of poor communities. Malnourished regions, for example, may benefit from enriched gummy sweets containing essential vitamins and minerals, whereas diabetes-prone areas may prefer low-glycaemic, sugar-free alternatives. Therefore, incorporating such regional insights into micro-credential training would enable entrepreneurs to address pressing health challenges through product creation. Finally, the global variation in studies on gummy candies as a healthy food alternative identifies a gap in the literature and provides an opportunity to widen entrepreneurial training to include culturally and regionally specific insights. As such, community-based businesses can create goods that appeal to local consumers while addressing wider health goals by factoring in varying dietary demands and health concerns during the creation process. This strategy expands the usage of gummy candies as a healthy snack option and aligns with the review's goal of strengthening community-based enterprises through targeted micro-credential training.

5. Discussion

When properly manufactured, gummy candies have the potential to be a good snack option. While typical gummy treats can be high in sugar, health-conscious gummies are also being manufactured with various essential nutrients. These include vitamins such as vitamin C for immunity, vitamin D for bone health, vitamin B12 for energy, and minerals like calcium [26]. Some gummies also contain probiotics, which help with digestion, as well as omega-3 fatty acids, which are essential for heart and brain function [26,27]. Furthermore, fiber-rich candies improve digestion and blood sugar control. Many health-conscious candies employ natural, organic ingredients and sugar substitutes like carob pods, guar beans, turmeric, black paper, pitahaya, red beetroot, spirulina, and konjac fruit [2,24,25,28–30]. Another tempting feature is that gummies are intended to deliver certain health benefits, such as joint wellness, skincare, or sleep help. Table 3 presents a summary of the findings from the SLR analysis.

Table 3. Discussion of the findings from selected articles

Title	Authors	Country	Year	Main Finding	Sample
Physicochemical and Sensory Stability Evaluation of Gummy Candies Fortified with Mountain Germander Extract and Prebiotics	Vojvodić Cebin, A., Bunić, M., Mandura Jarić, A., Šeremet, D., Komes, D.	Croatia	2024	The study demonstrated that gummy candies can effectively deliver herbal extracts and prebiotics such as mountain germander extract and fructooligosaccharides. This makes them a convenient and enjoyable way to incorporate functional ingredients into the diet while maintaining stability, texture, and consumer acceptance.	Product ingredients
Sugar-Free, Vegan, Furcellaran Gummy Jellies with Plant-Based Triple-Layer Films	Stępień, Anna; Tkaczewska, Joanna; Nowak, Nikola.; Grzebieniarz, Wiktoria.; Goik, Urszula.; Żmudziński, Daniel; Jamróz, Ewelina	Poland	2023	The study discovered that the algae-derived polysaccharide Furcellaran (FUR) can be used as a gel-forming agent to produce vegan, sugar-free gummy jellies with improved texture, antioxidant activity, and mechanical properties. This makes it a promising alternative to gelatin-based products while also promoting environmentally friendly packaging.	Product ingredients
Intake of Sugar Substitute Gummy Candies Benefits the Glycemic Response in Healthy Adults: A Prospective Crossover Clinical Trial	Gan, Dan; Xu, Minjun; Chen, Ling; Cui, Shaohua; Deng, Changyong; Qiao, Qian; Guan, Ruimiao; Zhong, Fang	China	2022	The study revealed that gummies made with sugar alternatives like maltitol and erythritol help regulate blood sugar better than typical sugar candy. Gummies with low or no sugar (P-SG and T-SG) had a lower glycaemic index, which helped to reduce blood sugar levels more effectively. These candies also released glucose more slowly throughout digestion, making them a better option for blood sugar management.	17
Gummies candy enriched with Konjac glucomannan reduces hunger intensity and waist circumference of overweight individuals	Fernandes ACS, Muxfeldt L, Motta NG, Skonieski C, Fagundes KR, Sandri G, de Chaves DB, Suthovski G, Gallina AL, Araujo SM, Benvegnú DM	Brazil	2023	The study revealed that eating gummy candies enriched with konjac glucomannan (KGM) for 14 days reduced waist circumference and hunger intensity in overweight adults. These findings suggested that KGM may aid in managing hunger and body weight, with higher doses potentially giving even better results.	42 (18-45 y.o)
Bio-Converted Spirulina for Nutraceutical Chewing Candy Formulations Rich in L-Glutamic and Gamma-Aminobutyric Acids	Elena Bartkiene, Ernesta Tolpeznikaite, Dovile Klupsaite, Vytaute Starkute, Vadims Bartkevics, Anna Skrastina, Romans Pavlenko, Ernestas Mockus, Vita Lele, Gabija Batkeviciute, Ausrine Budrikyte, Rusne Janulyte, Ieva Jomantaite, Auguste Kybartaite, Karolina Knystautaite, Aiste Valionyte, Romas Ruibys, João Miguel Rocha	Lithuania	2023	The researchers discovered that fermenting Spirulina increased the amount of helpful compounds, including L-glutamic acid and GABA, while also increasing its fatty acid profile. Fermented Spirulina improved the texture and color of sucrose-free gummy sweets, and participants preferred candies with xylitol and fragrant oils. This demonstrates that fermented Spirulina could be a healthy and advantageous ingredient for making nutraceutical gummy treats.	Product ingredients
A functional spreadable canola and milk proteins oleogels as a healthy system for candy gummies.	Salama HH, Hashim AF.	Egypt	2022	The researchers discovered that spreadable oleogels manufactured from canola oil and milk proteins can be utilized to make healthier gummies. These oleogels are high in protein, stable, and include beneficial fats and antioxidants. The gummies manufactured with them demonstrated good oil binding and antioxidant activity, indicating that oleogels are a promising ingredient for healthy food items.	Product ingredients
Improvement in the stability of betanin by liposomal nanocarriers: Its application in gummy candy as a food model.	Amjadi S, Ghorbani M, Hamishehkar H, Roufegarinejad L.	Iran	2018	The study discovered that betanin in liposomal nanocarriers performed better than free betanin in gummy sweets, demonstrating greater stability and antioxidant activity. The sweets' taste and texture were the same whether they contained betanin alone or in liposomes. This suggests that liposomal nanoparticles can boost betanin's effectiveness in health products.	Product ingredients

Table 3 continued

Current Innovations in the Development of Functional Gummy Candies.	Tarahi M, Tahmouzi S, Kianiani MR, Ezzati S, Hedayati S, Niakousari M.	Iran	2023	The review focused on the increasing desire for healthy, natural gummy candy, particularly among children. It discussed the use of alternative ingredients such as plant-based gelling agents, natural sweeteners, flavors, and colorants, as well as the addition of fiber, protein, antioxidants, and medicines to improve the texture, taste, and nutrition of gummies.	Product ingredients
Red beet extract usage in gelatin/gellan-based gummy candy formulation introducing *Salix aegyptiaca* distillate as a flavoring agent	Ehsan Moghaddas Kia, Sho'le Ghaderzadeh, Ali Mojaddar Langroodi, Zahra Ghasempour, Ali Ehsani	Iran	2020	The researchers discovered that gummy candies made with red beetroot extract, *salix aegyptiaca* flavor, and gellan gum had a better texture, more antioxidants, and a more appealing appearance. Gellan gum made the sweets harder and glossier, while red beetroot extract boosted their antioxidant properties. *Salix aegyptiaca* enhanced the candy's taste. These components have a strong potential for use in food products as colorants, flavors, and textures.	Product ingredients
Fully automatic measuring system for assessing masticatory performance using β-carotene-containing gummy jelly	T Nokubi, S Yasui, Y Yoshimuta, M Kida, C Kusunoki, T Ono, Y Maeda, F Nokubi, K Yokota, T Yamamoto	Japan	2013	The study discovered that a new technique using gummy jelly with β-carotene can properly quantify masticatory performance by measuring changes in the surface area. The greatest results were obtained by rinsing and dissolving the jelly for 10 seconds, demonstrating that the device can accurately assess chewing efficiency.	Product ingredients
Nanoliposomal encapsulation mediated enhancement of betalain stability: Characterisation, storage stability and antioxidant activity of Basella rubra L. fruits for its applications in vegan gummy candies	Sandopu Sravan Kumar, Attar Singh Chauhan, Parvatam Giridhar	India	2020	The researchers discovered that encapsulating betalains in lecithin nanoliposomes increased their color and durability by 76%. These nanoliposomes were stable for 40 days and more heat-resistant than native betalains. When added to gummy sweets, they improve color stability, texture, antioxidant activity, and shelf life, making them an effective natural food colorant.	Product ingredients
The effectiveness of xylitol in a school-based cluster-randomized clinical trial	Wonik Lee, Charles Spiekerman, Masahiro Heima, Hafsteinn Eggertsson, Gerald Ferretti, Peter Milgrom, Suchitra Nelson	USA	2015	According to the study, xylitol gummy bears did not reduce tooth decay any more than placebo gummy bears. Both groups got equal oral health treatments, and while tooth decay was low in both, xylitol provided no additional advantages. Other preventative tactics most likely obscured any potential effects of xylitol.	562
Microencapsulation of Betaxanthin Pigments from Pitahaya (Hylocereus megalanthus) By-Products: Characterization, Food Application, Stability, and In Vitro Gastrointestinal Digestion	María Carolina Otálora, Andrea Wilches-Torres, Jovanny A Gómez Castaño	Colombia	2023	The study reported that pitahaya peel by-products, which are rich in natural pigments and fiber, can be used to create stable, antioxidant-rich microencapsulated powders. When added to gummy candies, these powders improved the gummies' fiber content, texture, and color stability, making them a good natural alternative to synthetic colorants in food products.	Product ingredients
Vibrational and electronic spectroscopic detection and quantification of carminic acid in candies	Carlos Garrido, Ernesto Clavijo, Sylvia Copaja, Juan Gómez-Jeria, Marcelo Campos-Vallette	Chile	2019	The study demonstrated that Carminic Acid (CA) in gummy sweets may be detected and measured quickly and easily utilizing spectroscopic methods that do not require sample preparation. The results were accurate and matched standard testing procedures, which helped assure the safety of CA in candy for youngsters.	Product ingredients
Enhancing predicted fluoride varnish efficacy and post-treatment compliance by means of calcium-containing gummy bears	F Lippert, L Al Dehailan, G A Castiblanco, A A Tagelsir, C Buckley, G J Eckert	USA	2018	The study discovered that ingesting calcium gummies before applying fluoride varnish did not improve fluoride retention in plaque or aid in following post-treatment instructions. There was no significant difference between the gummy and non-gummy groups.	44 (7-12 y.o)

Table 3 continued

Human in vivo assessment of the survival and germination of Heyndrickxia coagulans SNZ1969 spores delivered via gummy candies	Susanna Perotti, Giacomo Mantegazza, Elena Pierallini, Natalja Kirika, Robin Duncan, Nicolò Telesca, Andrea Sarrica, Simone Guglielmetti	Italy	2024	The study reported that gummy candies could successfully deliver the probiotic heyndrickxia coagulans SNZ1969. The spores remained active for 24 months, and when consumed by adults, they germinated and stayed in the gut for two weeks after the candy was finished. This indicates that gummy candies can be a good way to deliver probiotics for gut health.	24
Lead in women's and children's vitamins	William R Mindak, John Cheng, Benjamin J Canas, P Michael Bolger	USA	2008	The study discovered that lead (Pb) levels in vitamins, including gummies, were below acceptable exposure limits for all groups (children, pregnant women, and adults). The majority of goods had Pb levels well below the maximum safe intake threshold; however, a few samples had greater concentrations. Overall, Pb exposure from these goods does not pose a significant health risk.	Product ingredients
Application of Plant-Based Hydrocolloids on the Textural Profile of Vegan Gummies Supplemented with Turmeric and Black Pepper	Santoshi Rawat, Sweta Rai, Sabbu Sangeeta, Anil Kumar, Preethi Ramachandran, Satish Kumar Sharma, Shiv Kumar Dubey, Arun Prakash, Riya Joshi	India	2024	The study discovered that using a mix of agar-agar and guar gum as plant-based substitutes for gelatin in gummies created a product with good texture, firmness, and elasticity. The combination of 1% agar-agar and 5.5% guar gum produced gummies that were chewy and well-liked by consumers. The gummies also contained turmeric and black pepper, adding health benefits like antioxidants and compounds such as curcumin and piperine. This plant-based alternative to gelatin offers a stable, vegan option for functional, healthier gummies.	Product ingredients
Review of history and mechanisms of action of lactulose (4-O-β-D-Galactopyranosyl-β-D-fructofuranose): present and future applications in food	Vid Vičič, Ruža Pandel Mikuš, Blaž Ferjančič	Slovenia	2024	Lactulose is a synthetic sugar that offers a variety of health benefits, including promoting healthy bacteria in the gut and acting as a laxative. It has been used safely in foods and supplements for over 60 years, including by babies and the elderly. Lactulose is sweet, soluble, and stable, making it a perfect substitute for sucrose in popular consumer items like gummy candies without additional sweeteners. Its health benefits and helpful properties make it an excellent ingredient in functional foods.	Product ingredients
Unripe carob pods: an innovative source of antioxidant molecules for the preparation of high-added value gummies	U. Gianfranco Spizzirri, Paolino Caputo, Rosa Nicoletti, Pasquale Crupi, Fabrizio D'Ascenzo, Cesare Oliverio Rossi, Maria Lisa Clodoveo, Francesca Aiello and Donatella Restuccia	Italy	2024	The researchers discovered that unripe carob pods contain antioxidants that may be removed using environmentally safe methods. These antioxidants were combined to form a gelatin conjugate, which was then used to manufacture gummies with high antioxidant activity and good structure.	Product composite testing

This study reported that gummy candies have the potential to be good transporters for a wide range of functional chemicals, making them a simple and appealing way to include health benefits into one's diet. Gummy candies may contain herbal extracts such as mountain germander and prebiotics such as fructooligosaccharides, which add nutritional benefits without losing taste or texture [26,27]. Furthermore, plant-based gelling agents such as FUR can be used instead of gelatin to create vegan, sugar-free chocolates with superior texture and antioxidant content [1]. Gummies containing sugar alternatives like maltitol and erythritol help regulate blood sugar more effectively, making them a better option for people who want to manage their glycaemic index [31,32]. The usage of konjac glucomannan in gummies has also shown promise in terms of reducing waist circumference and hunger intensity, which may aid in weight management. In addition, fermented Spirulina improves the nutritional profile and texture of gummies [25], whereas oleogels made from canola oil and milk proteins have higher fat and protein content [33]. Moreover, encapsulating betalains in liposomal nanocarriers improves their stability and antioxidant activity, hence extending the shelf life of gummies. While xylitol-based candies provided no additional benefits in terms of tooth decay reduction compared to placebo, they did improve overall oral health. Natural components such as pitahaya peel by-products contain antioxidants and colorants, and probiotics such as heyndrickxia coagulans are stable in gummies and provide gut health benefits [26]. At the same time, lead levels in gummies were proven safe, and lactulose as a sweetener improves functionality and stability. Finally, eco-friendly techniques involving unripe carob pods boost the antioxidant properties of gummies, increasing their health benefits. Overall, this study emphasizes the numerous applications of gummies as a functional food that can provide both enjoyment and health advantages.

5.1. Evaluation of Healthy Gummies Potential as a Healthy Food Alternative by Looking at Their Nutritional Content

Evaluating the potential of healthy gummies as a nutritious food alternative involves analyzing their nutritional content. These gummies are often formulated with natural sweeteners like stevia or agave syrup, plant-based pectin instead of gelatin, and natural colorants and flavors. For instance, Čižauskaite et al. [33] explored natural ingredients-based gummy bear composition, highlighting the use of agave syrup and plant-based pectin. In contrast, regular gummies typically contain high-fructose corn syrup, artificial colors, and flavors, as well as gelatin derived from animal collagen [33]. Studies have proven that healthy gummies can provide essential nutrients such as vitamins, minerals, antioxidants, and dietary fibers, which are often lacking in regular gummies [34].

Another key aspect is the inclusion of functional ingredients in healthy gummies. These gummies may contain added vitamins, minerals, antioxidants, and dietary fibers to enhance their nutritional value [3]. For example, Roudbari et al. [34] developed functional gummy candies with pistachio green hull extract, stevia, and starch, resulting in a product with high antioxidant activity and reduced sugar content. On the other hand, regular gummies lack these functional ingredients and are primarily designed for taste and texture rather than health benefits [35]. Meanwhile, research by Bharat et al. [36] demonstrated the use of watermelon juice, beetroot juice, plant-based pectin, and stevia to create a fiber-rich gummy that promotes healthy digestion and cardiovascular health.

Consumer preferences are also shifting towards healthier options, as indicated by research on fiber-rich gummies. A study by Bharat et al. [36] demonstrated the use of watermelon juice, beetroot juice, plant-based pectin, and stevia to create a fiber-rich gummy that promotes healthy digestion and cardiovascular health. This trend reflects a growing awareness of the importance of nutritious snacks, contrasting with the traditional appeal of regular gummies that focus on indulgence and convenience [36]. The development of low-calorie gummy jellies from Krueo Ma Noy leaves (*Cissampelos pareira* L.) by Hirunyophat et al. [37] also highlighted the potential of healthy gummies to meet consumers' energy restriction needs [37].

5.2. Evaluation of Healthy Gummies Potential as to Design Micro-Credentials Training Targeted towards Community-Based Entrepreneurship

Evaluating the potential of healthy gummies for designing micro-credential training in community-based entrepreneurship has recently become a relative topic of interest. Tambe et al. [38] delved into creating chewable gummies infused with *Cissus quadrangularis* extract, highlighting their health benefits and the innovation in gummy matrix technology to hold bioactive compounds. This research is a fascinating example of how we can develop new, convenient ways to promote health within communities [38]. On a similar note, Fauziah Saadah Abdul Halim et al. [39] crafted a framework for micro-credential courses in Malaysian higher education, stressing the importance of industry-aligned learning units that can build up to larger qualifications. We could definitely view this framework as being adapted to include practical elements like healthy gummies in entrepreneurial training programs [39].

Micro-credentials have become a hot topic for their ability to offer flexible, personalized learning experiences through short, verified courses that can be combined into more comprehensive skills or qualifications. Deloitte Access Economics [16] highlighted that micro-credentials cater to the evolving demands of the workforce, driven by digital innovation and the need for soft skills. This aligns

perfectly with the idea of using healthy gummies in training programs—providing an engaging and tangible way to teach entrepreneurial skills [40]. In addition, Che Ahmat et al. [41] also praised micro-credentials for delivering just-in-time value and personalized learning. Accordingly, by integrating healthy gummies into these programs, we can make the learning process more interactive and enjoyable, enhancing the overall experience [41].

Bringing healthy gummies into micro-credential training programs for community-based entrepreneurship also opens up opportunities for partnerships between educational institutions and industry. This adaptability can be harnessed to create training modules incorporating healthy gummies as a practical learning tool. Furthermore, the significance of digital badges and certificates in verifying specific skills can be used to recognize the completion of training programs involving healthy gummies [39]. Thus, by encouraging collaboration among educational institutions, industry stakeholders, and community organizations, we can fully realize the potential of healthy gummies as a tool for entrepreneurial training.

6. Conclusions

In conclusion, our study emphasizes the growing potential of gummy candies as an adaptable way to deliver functional compounds with various health benefits. Notably, gummies can be made healthier and more effective by incorporating plant-based gelling agents, sugar alternatives, prebiotics, probiotics, antioxidants, and other beneficial ingredients. The findings indicate that gummies can aid with blood sugar regulation, weight management, gastrointestinal health, and antioxidant activity, as well as cater to dietary preferences such as vegan and sugar-free choices. Furthermore, the use of natural colorants, encapsulated components, and ecologically friendly manufacturing methods enhances the appeal of gummies as a sustainable, useful food product. Nevertheless, as consumer demand for healthier, more enjoyable food options grows, gummies represent a promising and novel solution to meeting nutritional needs.

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Data Availability

The data that support the findings of this study are available from Tun Hussein Onn University of Malaysia (UTHM), but restrictions apply to the availability of these data, which were used under licence for the current study and so are not publicly available. The data are, however, available from the authors upon reasonable request and with the permission of Tun Hussein Onn University of Malaysia (UTHM).

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