Development of a model for evaluating the nutritional quality of bread and bakery products

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Summary

Knowledge of the nutritional quality of food is essential to fully understand the causes of food-related diseases and to suggest effective interventions. Bakery products play a central role in this, as they remain the staple food of human nutrition. At the same time, considerable disparities between countries require the adaptation of methods and nutritional profiles for evaluation of foods for each country or region. This study aimed to create a model for evaluating the nutritional excellence of gluten-containing and gluten-free bread and bakery products, adaptable for Moldova. The developed model included 151 products marketed in the country and focused on five essential nutritional components, namely, content of sugar, fibre, salt, sourdough and wholemeal or alternative flours. The level of quality was assessed on a 6-point scale: 5–6 points for "high quality", 3–4 for "medium quality" and less than 3 points for "low quality". Research showed that most gluten-containing bakery products on the market were of poor nutritional quality. Gluten-free products recorded a higher health-related balance, with almost half of the range being of medium or high quality.

Keywords

bread; bakery product; carbohydrate; nutrition education; nutritional quality

Health issues associated with modern life, such as obesity, type II diabetes or cardiovascular diseases, have emerged as a global and national epidemics. According to data provided by the National Agency for Public Health of the Ministry of Health of the Republic of Moldova, the share of mortality rate by the main categories of causes of death is as follows: 53.2 % circulatory system diseases, 12.6 % malignant tumours and 6.3 % disorders of the digestive system. The root cause analysis of these illnesses indicated a direct dependence on behaviour-related factors, which include imbalanced dietary habits, lack of physical activity and the surrounding psychosocial environment [1].

When considering nutritional patterns, it is crucial to recognize the significant impact of carbohydrates in comprehending the progression of these health conditions and developing practical interventions. In this context, bakery products, particularly bread, hold a pivotal position as they continue to be the cornerstone of human nutrition, supplying 70 % of the total food intake. Bread consumption habits vary from country to country, but on average approximately 50 kg of bread are consumed per capita per year in most countries. In Moldova, approximately 10 kg of bread is consumed per person each month, exceeding both Romania, where the monthly per capita consumption is 7.6 kg, and the average bread consumption level in Europe, which stands at approximately 4 kg per person per month [2]. Bread and bakery products are justified as an object of study not only by their omnipresence in the culture and eating habits of Moldovans, but also by the significant challenge they present for the nutrition of people with disorders related to gluten consumption. With increased focus on gluten-free dietary approaches, the composition and manufacturing processes of this food category have come under intense scrutiny, especially concerning their nutritional content.

An increasing number of published scientific studies indicate that evaluating the nutritional quality of food based on a single nutrient or a limited set of nutrients does not represent a comprehensive or accurate measure. Hence, practical

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approaches for assessing the nutritional content of food should encompass a range of factors. There is a series of established methods for evaluating the nutritional value of food items, focused on factors related to health and well-being. There are also many intricate techniques available, such as Nutrient Hazard Analysis and Critical Control Point, NutriScore, NutriInform Battery, and others, which are used in front-of-pack labelling systems [3, 4]. Nevertheless, the number of existing models and methodologies for assessing the quality of carbohydrate-based foods is limited. This is probably due to the high diversity of carbohydrate categories, their low structural homogenity and their impact on various health and disease parameters, added to the complexity of the formulas for evaluating their quality [5].

Drewnowski et al. [6] proposed a quality score for high-carbohydrate foods developed based on the Dietary Guidelines for Americans 2020–2025 [7], which considers the nutritional quality of legumes, vegetables and fruits. The model includes 10 % fibre and free sugar limits relative to carbohydrates. Another model was created to evaluate the quality of bread and cereal products, with a particular focus on the gluten-free product range [8]. This method considers five quantitative parameters, selected based on the references provided by the EU Regulation No. 1924/2006 [9]. The seven qualitative criteria are structured to highlight whether specific components are present, influencing the overall nutritional quality of the products being evaluated. These components include starch, whole-grain flours, sourdough as a fermentation agent, legume-based flours, flours from lesser-known grains and pseudocereals, fructose and emulsifiers like mono- and diglycerides of fatty acids. The diversity of types of methods and indicators also implies variety in the scales of data collection [10, 11]. At the same time, it should be taken into account that the prevalence of nutritional imbalance and related public health problems, together with the considerable disparities between countries (in terms of dietary habits and traditions), require that methods and nutritional profiles for foods be adapted for each country or region.

This study aimed to create a model for appraising the nutritional excellence of both gluten-containing and gluten-free bread and bakery products in accordance with national and international regulations. This endeavour to elaborate a model for evaluating the quality of such products, encompassing those with and without gluten, is current and entirely in line with the quality and safety aspects of Global Food Security (GFS). Additionally, it aligns with the Food and Agriculture Organization's (FAO) strategies for evaluating and ensuring Food and Nutritional Security [12]. The model proposed for development would represent the inaugural tool created in Moldova for assessing the nutritional value of bread and commercially available bakery products. Its formulation drew inspiration from the Food Quality Score model designed for carbohydrate-based foods [6, 13, 14] and the Morreale model [8]. The model is distinguished by its straightforward computation, making it suitable for evaluating both gluten-free bakery products and their gluten-containing counterparts.

MATERIALS AND METHODS

Selection of food products

The chosen product categories, classified according to the European Food Groups classification codes, comprised bread (code 01) and bakery items (code 05), such as crispbread and flatbread [15], available in the supermarkets of Chisinau city (Moldova). These categories included gluten-free products and their gluten-containing counterparts (Tab. 1).

Due to the lack of an available national database containing information about food products‘ chemical and nutritional content, data for assessing the quality of the chosen products was extracted from their product labels. Photographs of

Tab. 1. Categories of bread and bakery products.

Category	Food product code [15]	Number of products			
		Gluten-containing		Gluten-free	Total
		Local	Imported	Imported	
Bread	01	58	12	17	87
Crispbreads (pretzels, breadcrumbs, breadsticks)	05	26	10	17	53
Flatbreads (pita, lavash, tortillas)	05	6	–	5	11
Total		90	22	39	151

Tab. 2. Scoring in the developed FiZSIM model.

Component	Score		
	0 points	1 point	2 points
Sugar (free or added), per 100 g product [%]	≥ 5	< 5	–
Dietary fibre, per 100 g product [%]	< 6	–	≥ 6
Salt, per 100 g product [%]	≥ 1	< 1	–
Sourdough (as a fermentation agent)	No	Yes	–
Wholemeal flour and/or other flours (from legumes, pseudocereals, seeds, nuts)	No	Yes	–
Score interval	Qualification		
5–6 points	High quality		
3–4 points	Medium quality		
< 3 points	Low quality		

the packaging were taken and the details from the product labels (Franzeluta, Chisinau, Moldova; Şapte Spice, Chisinau, Moldova; Brodetchi, Orhei, Moldova; Balti Bread-baking complex, Balti, Moldova; Cuptorul Fermecat, Balti, Moldova; Milina bakery, Drochia, Moldova; Vel Pitar, Bucharest, Romania; Harry-Brot, Kiebitzweg, Germany; Biogreno, Kiel, Germany; Dan Cake, Chrzanów, Poland; Dr. Schär, Burgstall, Italy) were input into an spreadsheet using Compilation Tool version 1.2.1. FAO/INFOODS (Food and Agriculture Organization, Rome, Italy). The columns for which no data were identified on the product label were not filled in. Subsequently, these data underwent a process of organization and verification in order to eliminate duplications and errors. Also, other optional information was used from the labels, such as (depending on availability) fermentation agents, type of flour (cereals, pseudocereals) or addition of seeds, fruits, nuts. As a result, a total of 151 products were validated. The data collection period was February 2022 – February 2023. The analysis excluded pastry products, cereals for breakfast, grains and crackers. A mandatory criterion for selecting the products was that they had to be packaged.

Components identification and model score development

Considerable support in the identification and reasoned selection of components for the new model was provided by the systematic review and meta-analysis concerning carbohydrates quality and effects on human health, published in The Lancet [16] at the recommendation of the World Health Organization (WHO). The study measured the ability of various health indicators to predict the outcomes and laid the foundation for offering precise recommendations, especially regarding dietary fibre consumption. An advantage of this research lied in its association with critical aspects of high-carbohydrate products, specifically total mortality, mortality rates and the occurrence of nutrition-related non-communicable diseases [16]. The developed model as a novel tool to assess the nutritional quality of bread and bakery products in Moldova was based on quantitative and qualitative features. It was called FiZSIM (Fi – fibre, Z – sugar, in Romanian zahăr, S – salt, I – whole grains, in Romanian cereale integrale, M – sourdough, in Romanian maya). Quantitative components included free or added sugars, dietary fibre and salt. Quality components included sourdough (as a leavening agent) and wholemeal or other flours from cereals, pseudocereals, legumes, seeds or nuts. The score for each product was obtained by summing the points assigned to the quantitative and qualitative components. The model could achieve a maximum of five or six points for the "high quality" level (Tab. 2).

Statistical analysis

Statistical analysis was conducted using the Boxplot and Whisker chart, which visually illustrated the spread of numerical data and any asymmetry by presenting a dataset that included the lowest value, the first (lower) quartile, the median, the third (upper) quartile and the maximum score.

RESULTS

Component scores

The model score was calculated by quantifying the assigned values for each component (Tab. 3). Manufacturing technologies of bread and bakery products, as a rule, do not involve sugar in the

Tab. 3. Share of maximum scores granted per product category.

			Components of the model									
			Sugar		Dietary Fibre		Salt		Whole grains and/or other flours		Sourdough	
Reference proportion			< 5 %		≥ 6 %		< 1 %		Yes		Yes	
Score			1 point		2 points		1 point		1 point		1 point	
Type of products	Specifications	*n*	*n*	[%]	*n*	[%]	*n*	[%]	*n*	[%]	*n*	[%]
Bread	GC, from local producers	58	57	98.3	6	10.3	25	43.1	25	43.1	5	8.6
	GC, imported	12	7	58.3	2	16.7	2	16.7	9	75.0	0	0.0
	GF, imported	17	13	76.5	14	82.4	7	41.2	17	100.0	11	64.7
Crispbread	GC, from local producers	26	12	46.2	5	19.2	9	34.6	11	42.3	0	0.0
	GC, imported	10	7	70.0	2	20.0	2	20.0	3	30.0	1	10.0
	GF, imported	17	11	64.7	5	29.4	6	35.3	12	70.6	0	0.0
Flatbread	GC, from local producers	6	4	66.7	0	0.0	1	16.7	1	16.7	0	0.0
	GF, imported	5	3	60.0	4	80.0	1	20.0	5	100.0	1	20.0

GC – gluten-containing, GF – gluten-free, *n* – number of products.

composition or involve only small amounts. Thus, 98.3 % of the domestic bread assortment, 76.5 % of the gluten-free bread assortment and 58.3 % of the imported bread contained less than 5 % sugar, being assigned the maximum score of 1 point. A sugar content below 5 % was found in 46.2 % of local crispbreads, 70.0 % of imported crispbreads, 64.7 % of gluten-free crispbreads, 66.7 % of gluten-containing flatbreads (pita, lavash) and 60.0 % of gluten-free flatbread.

The fibre component played a significant role in this model, due to the solid scientifically proven benefits on human health. Most gluten-containing bread samples, both locally produced and imported, could be considered sources of fibre (average values of approximately 4.3 ± 3.5 % and 4.6 ± 4.0 %, respectively): 89.7 % and 83.3 % of the products, respectively, contained less than 6.0 % fibre, compared to gluten-free bread (8.1 ± 1.9 %), in which a content greater than 6.0 % was identified in approximately 82.4% of the products. Only 20.0 % of imported gluten-containing crispbreads were rich in fibre, surpassing the corresponding gluten-free products (29.4 % of products contained more than 6.0 % fibre). A portion of 80.0 % of gluten-free flatbreads were assigned the maximum score of 2 points.

A portion of 43.1 % of local bread with gluten and 41.2 % of imported gluten-free bread had a salt content lower than 1 gram per 100 grams of product. Less than 1 g of salt per 100 g of product was also presented by 34.6 % of local crispbread with gluten and 35.3 % of imported gluten-free crispbread.

Within imported products, 70.6 % of gluten-free crispbread as well as 75.0 % of gluten-free bread included in their composition seeds or nuts and/or flours made from a variety of whole grains or legumes.

Manufacturing trends and consumer preferences lean towards products with a long fermentation period and artisanal technologies, and their applicability seems to be found more in the manufacture of gluten-free bread (64.7 % of products contained sourdough), with the share of other products fermented with sourdough being below 20.0 %.

Model scores

After assigning points for each indicator, the total score was calculated and product rating was determined. According to the developed model, most bread and bakery products, except gluten-free bread and gluten-free flatbread, were of low quality, with a score below 3 points. A portion of 27.5 % of local bread obtained the average rating and only 3.5 % were of high quality. The score findings revealed that gluten-free bread is characterized by better nutritional balance. In this regard, 52.9 % of the gluten-free breads were classified as medium quality, while another 41.2 % received a superior quality rating (Fig. 1).

From a technological point of view, developing gluten-free products having the equivalent nutritional quality compared to their gluten-containing counterparts is a challenge due to the essential role of gluten in forming a solid protein network, which provides structure and allows the

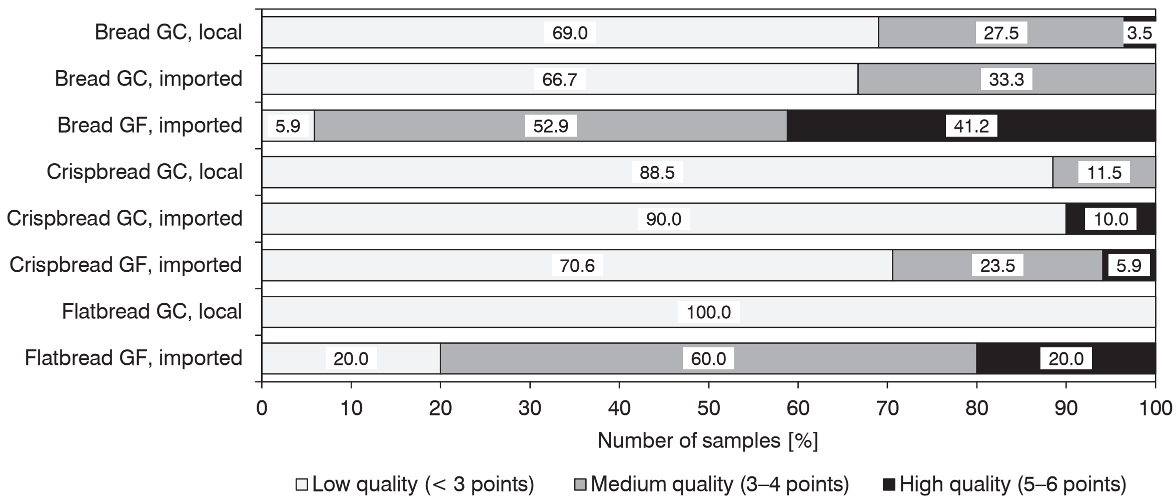

Fig. 1. Distribution of products according to total scores obtained based on the developed FiZSIM model.

GC – gluten-containing, GF – gluten-free.

retention of gases in bread and bakery products. Several studies [8, 17–19] dealt with developing and improving gluten-free bakery products focusing on technological and sensory aspects and less on the nutritional ones. According to some authors [20–22], only the presence of whole grains and/or multi-grain recipes in gluten-free bread do not guarantee good nutritional quality. Usually, the low dietary quality is associated with the presence of starch in this category of products, which potentially provides them with a high glycemic index.

In a separate study [23] that evaluated the nutritional quality of gluten-free products using a descriptive score called the "Health Star Rating", the assessment considered such factors as saturated fat, total sugar, sodium and the presence of specific food components like fruits, nuts, vegetables or legumes, as well as the content of protein and dietary fibre. This study revealed no substantial distinctions between gluten-free bakery products and their gluten-containing counterparts. Morreale [8] observed some attempts to improve the nutritional quality of gluten-free bakery products. The research undertaken in recent years to improve the technological and nutritional quality of gluten-free bakery products has yielded good results, contributing to increasing the nutritional quality of this product category. The results obtained according to the developed model showed a higher share of "high quality" and "medium quality" gluten-free breads compared to local and imported gluten-containing breads. The obtained scores could be due to the high fibre content in most gluten-free products, by including a varied and mixed assortment of pseudocereal flours, legumes or seeds but also by applying certain technological processes of term-long fermentation with sourdough.

Statistical analysis

The boxplot for gluten-free breads indicated that this category had recorded the highest nutritional quality scores. The median and mode scores were 4 and the average score was 4.47. The scores for gluten-free bread products ranged from 2 to 6, with the lower quartile (Q1) equal to 3.5 and the upper quartile (Q3) equal to the maximum value of 6. There were no outliers in this

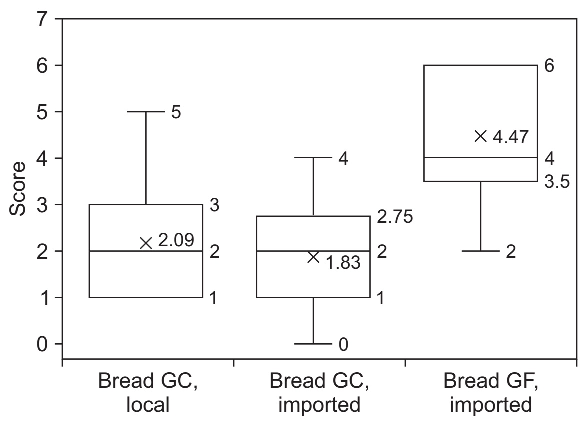

Fig. 2. Comparative distribution of FiZSIM model score values for bread.

GC – gluten-containing, GF – gluten-free.

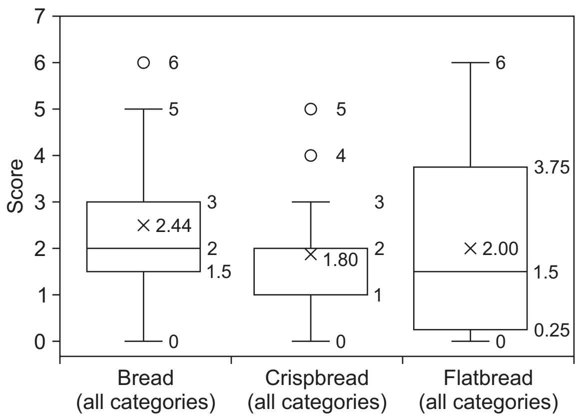

Fig. 3. Comparative distribution of FiZSIM model score values for bread and bakery products (crispbread and flatbread).

category, suggesting that most gluten-free bread products had high nutritional quality, with a concentration around the upper quartile. Local and imported bread products had similar median and mode scores, but local breads had a slightly higher average score. Gluten-free bread products had the broadest range of scores, with no outliers. These results provided insights into the nutritional quality of various types of bread based on the developed FiZSIM model (Fig. 2).

Comparative analysis of the scores of the analysed product categories showed a wider dispersion of data for flatbread compared to bread or crispbread. Score values for all product categories were characterized by asymmetry and outliers (Fig. 3).

DISCUSSION

Early models highlighting the quality of carbohydrates-containing foods were primarily based on favourable total carbohydrates content, free sugar, added sugar and fibre content [5, 18]. Drewnowski et al. [6, 14] proposed a Carbohydrate Food Quality Score 5 (CFQS-5), which complemented the two components of fibre and free sugar from previous models with additional dietary ingredients sodium, potassium and whole grains [13]. The model recommended reducing the consumption of sugar and sodium while increasing the consumption of whole grains, fibre and potassium. The upper limit level for sodium was 600 mg sodium per 100 g of the food product on dry weight basis. The limit for potassium was 300 mg per 100 g of the food product on dry weight basis. These values roughly corresponded to the median values for each nutrient in the 2017–2018 Food and Nutrient Database for Dietary Studies [24]. The model could obtain a maximum score of five points. In this case, the product would be qualified as being of “superior quality”. According to the CFQS-5 model, sweet bakery products were rated with 2 points or less, and the majority of foods from mixtures of cereals, bread and savory snacks were rated with 3 points.

Another model was developed to assess the quality of bakery products, especially the gluten-free ones [8]. The method considered two groups of parameters, both quantitative and qualitative. Quantitative parameters included total and saturated fat, sodium, fibre and sugar. The parameters were selected based on the references provided by the EU Regulation No. 1924/2006 [9]. As for the quantitative parameters, the model could obtain a maximum of seven points for the “superior quality” category. The qualitative parameters took into account the presence or absence (Yes/No) of the following components: starch, whole-grain flours, sourdough (used as a fermentation agent), legume-based flours, other flours from lesser-known grains and pseudocereals, fructose and emulsifiers. Based on the results of this study, the nutritional quality of Italian gluten-free bakery products was evaluated as low and comparable to that of gluten-containing counterparts. That result was largely due to starch, a component included in the Morreale model, the presence of which in the product equated to zero points [8].

The FiZSIM model differs from the CFQS-5 model, proposed by Comerford et al. [13] and Drewnowski et al. [14], by two components, as it includes sourdough and does not include potassium. Potassium was identified as a deficient nutrient in the Dietary guidelines for Americans 2020–2025 [7] and was included in the model to improve both the selection of carbohydrates-containing foods and the overall quality of American diets. The model did not incorporate the starch component, due to its omnipresence in most gluten-free products and because it constitutes the major content in cereal flours, which would compromise the perceived quality of these products right from the start. The role of free sugar as the determinant of adverse health impacts has been elucidated and clear guidelines have been issued regarding their restriction [16]. The awareness level of sugar intake has increased due to its association with obesity, type 2 diabetes and cardiovascular disease. The regulations on nutrition and health claims made on foods stipulate a maximum of 5 g of sugar per 100 g of product. That way, the product could carry the low-sugar label. These sugar content values also correspond to other models for assessing the quality of carbohydrates-containing products [6, 8]. In Moldova, the mass fraction of sugar in bread and bakery products made from wheat flour is regulated according to the manufacturing recipe. It constitutes a minimum of 2.0 kg per 100 kg of flour. For the above reasons, sugar was included in the developed model, but with a reference value of < 5 % for assigning the maximum score.

Increased dietary fibre or whole grain consumption is linked to a decreased risk of mortality from non-communicable diseases. It has been over 50 years since researchers observed that the processing of grain-based foods, involving the removal of dietary fibre, was more important in determining the risk of cardiometabolic and significant intestinal diseases than excessive sugar consumption [1]. Significant research findings indicate that there is a positive relationship between the consumption of fibre and a decrease in various illness indicators, including overall mortality, cardiovascular disease-related deaths, stroke incidence, and the occurrence of colorectal cancer, breast cancer and oesophagal cancer [16]. Consuming higher amounts of dietary fibre or whole grains shows a more distinct connection with positive health outcomes compared to measures like glycemic index. It is recommended that adults aim for a daily dietary fibre intake of at least 25–29 g per day, with additional and possibly cumulative health benefits if fibre intake is higher [1, 16, 19]. European Food Safety Authority (EFSA) recommends a daily fibre intake of 25 g for adults [25, 26]. Food and Drug Administration increased the recommended daily fibre intake to 25–28 g for every 2 000 calories while Nordic Nutrition Recommendations suggests an even higher amount, up to 35 g of fibre per day [27]. Considering the importance and proven benefits of fibre consumption, the score for this indicator was from 0 to 2 points (for fibre values ≥ 6 %, 2 points; for values below 6, zero points). The model placed considerable importance on the fibre component due to the robust and well-established evidence of its positive impact on health.

Sodium is vital in maintaining regular cell functioning and transmitting nerve signals [28]. In the context of public health, numerous national and international organizations assessed the consequences of excess salt consumption on health, with a particular focus on its influence on blood pressure, cardiovascular health, stomach cancer and kidney function. Governments were urged to adopt measures to reduce salt intake. The lowest physiological requirement for sodium is approximated to range between 200 mg and 500 mg per day, which equates to approximately 0.5–1.25 g of salt daily [28]. These values are lower compared to the EFSA recommendations [25] of 1.5 g per day of sodium (corresponding to 3.8 g of salt per day) in adults. Bakery items, particularly bread, hold ta significant position in this context, as they are widely consumed globally and often represent the primary source of sodium intake. In Moldova, the salt content in bread and bakery products is subject to regulation (Tab. 4).

Tab. 4. Reference values of salt content in bakery products [29–32].

Country	Reference values of salt content
Moldova	Iodized salt – 1.5 % (from 1 June 2024 – 1 %)
Romania	1.5 %
Hungary	> 1.3 %; < 2.5 %
Belgium	Maximum 2.0 % salt per dry matter (1.7 % in flour or 1.2–1.4 % in the final product)
Portugal	≤ 1.4 %

Regarding the national guidelines, from 1 June 2024, the limit of salt in bakery products will be set at 1 g of salt per 100 g of product [29]. The highest score for this criterion was awarded 1 point if the salt content in bread and bakery products was less than 1 %. The salt threshold selected for the developed model (less than 1 % salt to score 1 point) differed from the regulation specifying 0.3–0.6 % salt [9, 33]. Reducing salt to 0.3–0.6 % is feasible without affecting the technological properties of the product when baking, but not without influencing the sensory characteristics. When decreasing the sodium chloride content in bakery items, it is essential to consider various effects this substance has on their technical, functional and sensory attributes. There is no agreement on the most effective approach or the ideal sodium level [34].

The health benefits of whole grains are similar to those of dietary fibre [22, 35]. Incorporating whole grains into the diet offers a valuable way to boost the dietary fibre intake and lower the risk of non-communicable diseases [16]. Inclusion of alternative flours, seeds rich in dietary fibre or proteins in bread formulation represents a common practice that can be synergistic and, at the same time, allows to partially substitute such ingredients as starch or refined flours, improving the protein profile through the supply of essential amino acids and contributing to the formation of texture, as a result of the binding properties of some flours and seeds.

The importance of sourdough in dough fermentation was confirmed by several studies that revealed its contribution to improving sensory properties, nutritional value and shelf life. Over the past few years, sourdough fermentation has been integrated into the manufacturing of gluten-free bread on industrial scale. This was motivated by its beneficial impact on the gut microbiota [8, 36]. Currently, the bakery industry enjoys a continuous demand for innovative products, which reflects the interest in longer fermentation, using artisan fermentation agents and carefully selecting raw materials [37]. Including sourdough in the formulation of bakery products could help to reduce the amount of salt in the recipe, possibly due to the combined effects of increased acidity on proteolysis, while maintaining palatability. Individual combinations of microorganisms and raw materials along with the processing conditions gives individual sourdough-fermented products unique characteristics [38, 39].

This study was based on the information extracted from product labels since there is no national database containing data on the chemical and nutritional composition of food products. This approach might lead to inaccuracies or variations in the reported values. The study focused on bread and bakery products available in Chisinau, Moldova. The generalizability of the findings to other regions or countries may be limited, as dietary habits and product availability can vary significantly. The study excluded such bakery products as pastry, breakfast cereals, grains or crackers. This exclusion might impact the comprehensiveness of the model, especially if these products play a significant role in the overall diet. While addressing key nutritional components, the developed model may not encompass all aspects of nutritional quality. Other relevant factors might not be considered in the model, which could influence the overall quality of bread and bakery products. The study did not provide specific recommendations or interventions for improving the nutritional quality of bread and bakery products. Future research could explore strategies for manufacturers and policymakers to enhance the quality of these products.

CONCLUSIONS

In the context of a global and national pandemic of non-communicable diseases, where the circulatory system diseases, malignant tumours and digestive disorders are important contributors to mortality, it is crucial to address dietary patterns, which significantly impact public health. Bread and bakery products are staples in many diets and play a central role in shaping the nutritional landscape. Their quality, particularly in the presence or absence of gluten, requires meticulous evaluation. The authors of this study developed FiZSIM model as a novel tool to assess the nutritional quality of bread and bakery products in Moldova. The research showed that most of the bread and bakery products available on the local market, both gluten-containing and gluten-free, recorded low nutritional quality, with scores below 3 points. However, it was noted that gluten-free products demonstrated a better balance regarding health effects, with almost half of the assortment categorized as medium or high quality. This finding was primarily attributed to their increased fibre content and the inclusion of a diverse range of pseudocereal flours, legumes, seeds or sourdough. The FiZSIM model focused on essential nutritional components, including sugar, dietary fibre, salt, wholemeal flour, pseudocereals, seeds, nuts and sourdough. It aligned with international nutritional recommendations and aims to provide consumers with a practical tool for making informed choices regarding bread and bakery products. Nevertheless, it is essential to acknowledge the limitations of our research, such as data reliance on product labels, regional variations and the exclusion of specific bakery products. Future research endeavours should aim to explore strategies for improving the nutritional quality of bread and bakery products, addressing factors that were not included in this model and providing specific recommendations for both manufacturers and policymakers. In the effort to combat the rise of diet-related diseases, the development and refinement of models like FiZSIM represents a vital step towards better public health through informed food choices.

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