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FOOD AND ENVIRONMENT SAFETY

EVALUATION OF THE NUTRITIONAL QUALITY OF BREAKFAST CEREALS AVAILABLE ON THE ROMANIAN MARKET

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Abstract: *This study evaluated the nutritional quality of 119 breakfast cereal products available on the Romanian market, including cereal bars, muesli, flakes, bran cereals, and cereals with fillings or coatings. Products with and without gluten were compared. Nutritional parameters analyzed included energy value, total fat, carbohydrates, sugars, protein, salt, and dietary fiber. Results revealed substantial variability across cereal types, with cereal bars, muesli, and bran cereals exhibiting the highest energy and fat content per 100 g. Gluten-free products generally showed slightly higher energy and protein levels, while gluten-containing cereals had marginally higher fat and fiber content. Differences between products with and without gluten were otherwise limited. The findings indicate that regulated label information alone may not reliably reflect the overall nutritional quality of breakfast cereals, highlighting the importance of careful interpretation of product labels to inform consumer choices. Breakfast cereals provide a significant source of carbohydrates, contributing approximately 10% of daily caloric intake for adolescents. These results underscore the need for transparent and informative labeling to facilitate healthier dietary decisions.*

Keywords: *breakfast cereals, carbohydrates, dietary fiber, energy value, fat, gluten, protein*

1. Introduction

Breakfast is widely acknowledged as the most important meal of the day, serving as the initial source of essential nutrients after an overnight fast [1]. Regular consumption of a nutritionally balanced breakfast has been shown to support cognitive function, enhance physical performance, and regulate energy balance, whereas habitual breakfast omission is associated with nutrient deficiencies, impaired mental and physical functioning, suboptimal weight management, and the establishment of long-term unhealthy dietary patterns [2].

Current dietary guidelines recommend that breakfast contribute approximately 15–25% of daily energy intake and incorporate a minimum of three core food groups, including dairy products, fruits, and cereals, preferably whole grains, given their rich nutrient profile and potential role in chronic disease prevention [3]. Among these, cereals are a major source of carbohydrates and also contribute important nutrients such as dietary fiber, B vitamins, vitamin E, magnesium, and zinc, which play key roles in supporting health throughout life [4, 5, 6].

Ready-to-eat breakfast cereals represent a particularly convenient dietary option due to their extended shelf life and ease of preparation; however, their nutritional quality is largely contingent upon both ingredient composition and processing techniques [7].

Given the centrality of cereals in breakfast consumption worldwide, a comprehensive understanding of their nutritional contributions is critical for informing dietary recommendations and promoting optimal nutrient intake as part of a healthy dietary pattern [8, 9].

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2. Materials and methods

2.1. Food Products

A total of 119 breakfast cereal products were systematically collected from the online platforms of major Romanian supermarkets between October 2021 and May 2022. Products were included in the study if complete nutritional information was available, product images were clear, and items were in stock. Products with incomplete nutritional data, unclear labeling, or unavailable stock were excluded to ensure the accuracy and reliability of the dataset.

2.2. Data Collection

Nutritional information was extracted from product labels and included the following variables: company, brand, product name, energy (kcal/100 g), total fat, saturated fat, carbohydrates, sugars, protein, fiber, and salt content. Additionally, the presence or absence of gluten was recorded. Among the 119 products examined, 31 were classified as gluten-free, while 88 were found to contain gluten. Products were classified into six categories: cereal bars (n=30), muesli (n=28), flakes (n=13), bran cereals (n=3), puffed cereals (n=25), and other cereals containing fillings or honey (n=20), facilitating structured comparison of nutritional profiles across cereal types.

2.3. Data Analysis

All collected data were organized and processed using Microsoft Excel. Descriptive statistics, including mean, minimum, and maximum values, were calculated for each nutritional variable. The nutritional composition of the products was evaluated against the recommended daily intake values established by the World Health Organization (WHO) [10]: energy (1300–3500 kcal), protein (44–137 g), total fat (49–113 g), carbohydrates (143–521 g), salt (≤ 5 g/day), and sugar (45–50 g/day for adults; 25–35 g/day for children).

This analysis enabled the assessment of the contribution of individual breakfast cereals to daily nutrient intake and identification of potential nutritional imbalances.

3. Results and discussion

3.1. Energy Content

The analyzed breakfast cereals exhibited a wide range of energy content (176–510 kcal/100 g) (Fig. 1).

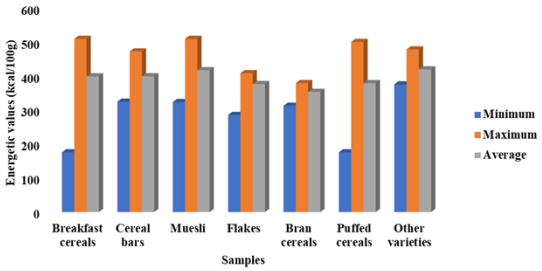

Fig. 1. Energetic value of analyzed samples (kcal/100g)

Bran cereals had the lowest mean energy (354 kcal/100 g), while cereals with fillings or glazes were the most energy-dense (420.1 kcal/100 g). Gluten-free cereals showed slightly minum energy value (356 kcal/100 g) than gluten-containing products (176 kcal/100 g) (Table 1). Relative to the WHO recommended daily energy intake (1300–3500 kcal/day), typical servings of most cereals provide a moderate contribution to daily energy.

However, consumption of energy-dense varieties, particularly those with fillings or glazes, may substantially increase caloric intake when combined with other meals, potentially contributing to excessive energy consumption. These findings align with previous studies demonstrating higher energy content in sugar- or fat-enriched cereals compared to bran or minimally processed types.

Table. 1

Composition of gluten and gluten-free cereals

Products		Energetic value (kcal/100 g)	Fat (g/100g)	Carbohydrates (g/100g)	Sugars (g/100g)	Proteins (g/100g)	Salt (g/100g)	Fiber (g/100g)
Gluten-containing cereals	Minimum	176	0.42	74.4	1.8	0.64	0	1.7
	Maximum	499	28	201.0	86.8	16.5	22.4	35
	Average	399.03	8.33	166.25	52.48	8.32	0.67	6.59
Gluten-free cereals	Minimum	356	0.7	15.0	4.5	2.6	0	0.6
	Maximum	510	23	205.6	87	16.3	2	16.3
	Average	401.27	7.2	165.58	60.06	8.54	0.6	5.55

3.2. Fat Content

Fat content varied widely among the analyzed cereals, ranging from 0.42 g/100 g in puffed cereals to 28 g/100 g in muesli. Muesli exhibited the highest mean fat content (10.98 g/100 g), while bran cereals had the lowest (1.9 g/100 g) (Fig. 2).

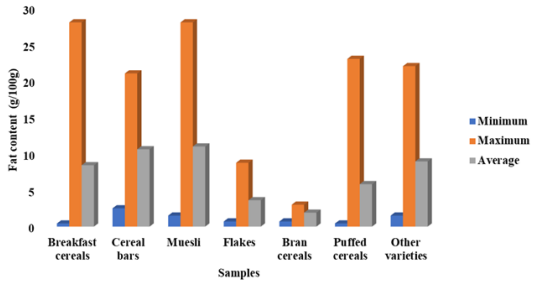

Fig. 2. Fat content of analyzed samples (g/100g)

Gluten-containing cereals showed slightly higher mean fat (8.83 g/100 g) compared to gluten-free products (7.2 g/100 g) (Table 1). Although most cereals contribute fat levels well below the WHO recommended upper intake (49–113 g/day), high-fat products, particularly certain muesli types, may significantly increase total dietary fat intake if consumed in large portions [10]. These findings highlight the considerable variability in fat content among breakfast cereals and underscore the importance of careful product selection to manage overall fat consumption.

3.3. Carbohydrate Content

Carbohydrate content varied widely among cereals, ranging from 74.4 g/100 g in puffed cereals to 205.6 g/100 g in filled or glazed cereals (Fig. 3).

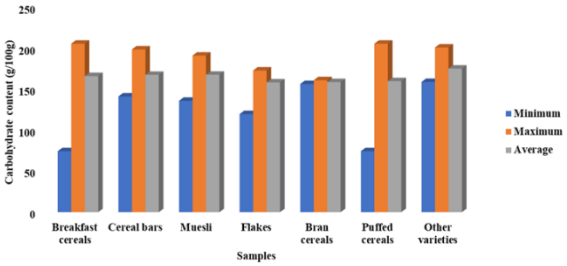

Fig. 3. Carbohydrate content of analyzed samples (g/100g)

Gluten-containing cereals exhibited slightly higher mean carbohydrate content (166.25 g/100 g) compared to gluten-free products (165.58 g/100 g) (Table 1).

In relation to the WHO recommended daily carbohydrate intake (143–521 g/day), breakfast cereals constitute a substantial carbohydrate source, providing a significant contribution to daily energy, particularly for children or individuals with high energy requirements. However, cereals with extremely high carbohydrate content may contribute to excessive intake if not balanced with adequate protein and fiber.

3.4. Sugar Content

Sugar content exhibited pronounced variability among breakfast cereals, ranging from 1.8 to 87 g/100 g (Fig. 4). Flakes contained the highest mean sugar (77.45 g/100 g), whereas muesli had the lowest (32.47 g/100 g). Gluten-free cereals

demonstrated slightly higher sugar content than gluten-containing products (Table 1).

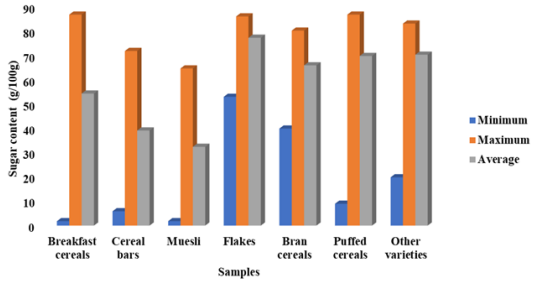

Fig. 4. Sugar content of analyzed samples (g/100g)

In comparison with WHO daily sugar intake recommendations (45–50 g/day for adults; 25–35 g/day for children), several cereals-particularly flakes and filled or glazed varieties-may substantially contribute to sugar overconsumption. These findings underscore the importance of careful cereal selection, especially in pediatric diets or for individuals monitoring sugar intake.

3.5. Protein Content

Protein content ranged from 0.6 g/100 g in cereal bars to 16.5 g/100 g in cereals with fillings. Bran cereals had a mean protein content of 10.77 g/100 g (Fig. 5).

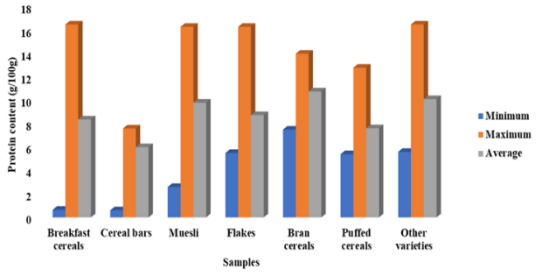

Fig. 5. Protein content of analyzed samples (g/100g)

Gluten-free cereals contained slightly higher protein (8.54 g/100 g) than gluten-containing products (8.32 g/100 g) (Table 1). Relative to WHO daily protein recommendations (44–137 g/day), most cereals provide a moderate contribution, supporting their role as part of a balanced breakfast but requiring complementary protein sources to meet total daily requirements.

3.6. Salt Content

Salt levels ranged from 0 to 22.4 g/100 g, with cereal bars showing the highest mean content (1.2 g/100 g) (Fig. 6).

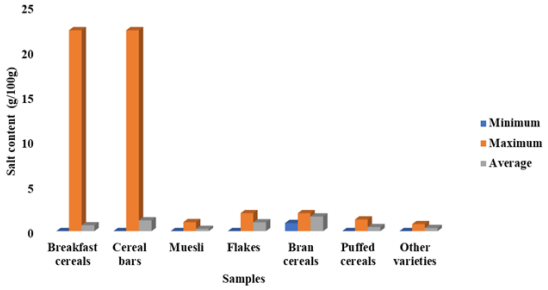

Fig. 6. Salt content of analyzed samples (g/100g)

Gluten-containing cereals had marginally higher mean salt content (0.67 g/100 g) than gluten-free cereals (0.6 g/100 g) (Table 1). Considering the WHO limit of ≤5 g/day, most cereals contributed minimally to daily salt intake, although certain cereal bars could meaningfully increase overall sodium consumption if consumed frequently.

3.7. Fiber Content

Dietary fiber varied substantially (0–35 g/100 g), with bran cereals exhibiting the highest mean fiber content (14.67 g/100 g) and filled/glazed cereals the lowest (3.81 g/100 g) (Fig. 7).

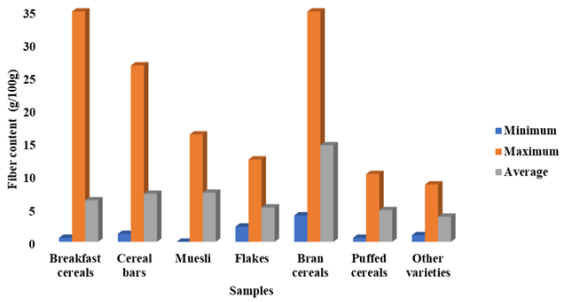

Fig. 7. Fiber content of analyzed samples (g/100g)

Gluten-containing cereals had higher mean fiber content (6.59 g/100 g) compared to gluten-free cereals (5.55 g/100 g) (Table 1). Fiber-rich cereals, particularly bran varieties, can significantly contribute to

meeting WHO recommendations for a balanced diet, promoting gastrointestinal health and reducing risk factors associated with chronic diseases.

4. Conclusion

This study evaluated the nutritional composition of 119 breakfast cereals available on the Romanian market, including both gluten-free and gluten-containing products. The analysis revealed considerable variability in energy, macronutrient, sugar, salt, and fiber content across different product categories. Gluten-free cereals displayed slightly higher energy and protein values but tended to have lower fat and salt levels compared to their gluten-containing counterparts. When compared with World Health Organization dietary recommendations, several products, particularly those high in sugar and fat, were found to contribute disproportionately to daily intake, posing potential risks for excessive consumption. Conversely, bran-based cereals provided significant amounts of dietary fiber and protein, supporting their role in promoting balanced diets. These findings highlight that front-of-package claims, such as "gluten-free," should not be interpreted as indicators of superior nutritional quality. Instead, informed consumer choices require careful evaluation of the full nutritional label. Future reformulation efforts by manufacturers could focus on reducing added sugars and saturated fats while enhancing fiber content, thereby aligning breakfast cereals more closely with international dietary guidelines and supporting healthier eating patterns.

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