

NUTRITIONAL EVALUATION OF COOKED SAUSAGES IN THE MARKET OF THE REPUBLIC OF SERBIA USING THE NUTRI-SCORE METHODOLOGY

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Abstract: Enhancing diet quality is a recognized strategy for reducing the burden of non-communicable diseases (NCDs), making it a primary focus of public health policies worldwide. The Nutri-Score, a front-of-pack labeling logo utilizing five color-coded letters (A, B, C, D, E), has been established as a means to assist consumers in promptly identifying healthier prepackaged foods within a given food category. It has a positive influence in terms of consumer awareness, perception, comprehension, and purchasing behavior and potentially contributes to a decrease in the prevalence of NCDs. The objective of this research was to assess the Nutri-Score of finely and coarsely ground cooked sausages available in the Serbian market. To accomplish this, a total of 189 packaged cooked sausages from the eight largest supermarket chains in the Belgrade region of the Republic of Serbia were analyzed. The sausages were evaluated using the Nutri-score method and categorized accordingly. The results of the Nutri-Score analysis revealed that only 1.1% of the cooked sausages fell into Group C, while 62.4% were classified as Group D, and 36.5% were classified as Group E. The reduction of sodium and saturated fatty acids, which are major contributors to unfavorable Nutri-scores in cooked sausages, is crucial due to their significant presence, often leading to their classification as "unhealthy foods."

Key words: Nutri-score, front-of-pack labelling, cooked sausages, saturated fatty acids

Introduction

The World Health Organization's Global Monitoring Framework on non-communicable diseases sets an overall target of achieving a 25% relative reduction in mortality from cardiovascular disease, cancer, diabetes, and chronic respiratory diseases among individuals aged 30-70 years by 2025, with one of the specific goals includes prevention of any increase in the prevalence of diabetes and obesity in the population (WHO, 2013). As poor dietary quality is a leading modifiable risk factor for obesity and non-communicable diseases, the World Health Organization (WHO) emphasizes the importance of promoting healthier food choices (Magnusson et al., 2019). For this to happen, consumers need to be able to distinguish between healthier and less healthy products. Hence, it is critical that consumers are well-informed about the nutritional content of food products. Nutritional labeling is a vital intervention that can aid consumers in making informed decisions and improving their diets' healthfulness (Bossuyt et al., 2021). The popularity of Front-Of-Pack labeling is a direct result of the numerous studies showing that conventional nutritional information, including text and back-of-pack labels, which are now mandatory in most countries, including Serbia (*Official Gazette of RS, No. 23/2022*), has little impact on consumers' dietary choices: they are frequently disregarded, misinterpreted, and do not result in action (Grunert et al., 2010; Chantal et al., 2017). The primary objective of Front-of-pack nutrition labeling is to enhance consumers' comprehension of the nutritional value of foods, facilitate informed food selection by consumers, as well as to incentivize manufacturers to reformulate their products with healthier ingredients (Delhomme, 2021). The available literature suggests that in experimental environments, the majority of Front-Of-Pack nutrition labels have a favorable impact on consumers' ability to recognize the healthier option as compared to a scenario where no label is provided (Ducrot et al., 2015; Roseman et al., 2018; Finkelstein et al., 2018). Consumers tend to show a preference for Front-Of-Pack labels over traditional nutrition declarations in terms of their attractiveness, and further research indicates that evaluative schemes which utilize color-coding, particularly those with a color-coding graded indicator, are the most effective at helping consumers of different ages, cultural backgrounds, and socio-economic status identify healthier food choices, as demonstrated in an international study by Egnell et al. (2018), which was supported later on with numerous research (Storcksdieck et al., 2020; Fondevila-Gascón et al., 2022). The Nutri-Score, a color-coded Front-of-pack indicator used to classify foods based on their nutritional value, is gaining popularity in Europe. Initially developed and implemented in France, it is currently being adopted by an increasing number of EU Member States, including Austria, Belgium, Germany, Luxembourg, The Netherlands, Portugal, and Spain (Delhomme, 2021). The Nutri-Score employs a five-point scale, ranging from the

healthiest to the least healthy, which employs a combination of colors and letters to rank food items (Figure 1). The healthiest products are assigned an A score and are indicated by a dark green color, while the least healthy option receives an E score and is highlighted in red. It is based on a nutrient profiling system that considers both beneficial and unfavorable food components. Food products that contain ingredients such as fruits, vegetables, nuts, fiber, and proteins are given a better overall score, whereas those with high energy content, sugar, saturated fatty acids, and salt leads to a worse score (Chantal *et al.*, 2017). The French Public Health Agency, which developed the Nutri-Score, has modified the algorithm to include olive oil, nuts, and rapeseed oils as favorable components, following scientific evidence, especially from recent intervention studies with olive oil (Herberg *et al.*, 2021). To summarize, the Nutri-Score represents a general food rating system that aims to assist people in making informed choices about their overall diet and to enable comparison of products within the same category (e.g., helping consumers to choose between two hot dogs).

Material and Methods

This study adopted a descriptive research design to analyze food labels provided by manufacturers of 189 pre-packaged cooked sausages. Data collection was conducted across 29 retail stores affiliated with the 8 largest supermarket chains in the Belgrade region of the Republic of Serbia, with the objective of maximizing the representation of available products. The data on the samples were collected based on the leading retailers currently present in the Serbian market, including LIDL Serbia, Delhaize Serbia (sales divisions: Maxi, Shop & Go, and Tempo Centar), Mercator S (sales divisions: Idea and Roda), DIS, Metro, Univerexport, Aman and Sunce (Qvattro company) containing a wide variety of domestic as well as foreign products manufacturers. The data collection period spanned from March to May 2023. Cooked sausages are classified by the Rulebook on the Quality of Minced Meat, Meat Products, and Semi-Processed Meat Products (*Official Gazette of RS*, 50/2019; 34/2023) into four separate categories: finely ground cooked sausages, coarsely ground cooked sausages, cooked sausages with meat pieces and meatloaf. Despite their efforts, the researchers were unable to find any products labeled as cooked sausages with meat pieces and meatloaf on the market shelves during the data collection time. The two remaining groups of meat products were classified by the researchers according to their common use from a consumer's perspective, with similar items being grouped together into categories, but also bearing in mind the classification provided by the *Official Gazette of RS* (50/2019; 34/2023). Classification was conducted as follows: finely ground cooked sausages – hot dog sausages, hot dog-type sausages (products marketed under a different name), frankfurter sausages, white sausages, Bologna sausage (original in

Serbian: *parizer*) and Bologna-type sausages (products marketed under a different name); as for the coarsely ground cooked sausages – mortadella, Srpska sausage, Tirolska sausage, Tirolska-type sausage (usually under the name of Alpska sausage; products marketed under a different name) and products marketed under a different name (some of the many product names include: Grill sausage, Smoked sausage, Domaća sausage, Kranjska sausage ect.).

Nutri-scores were calculated by the method proposed by *Chantal et al. (2017)*. To summarize, the model employs a straightforward scoring system that assigns points based on the nutrient content of 100 grams of food. The points are allotted for both the A nutrients – positive points category (energy, saturated fat, total sugar, and sodium content) and category C nutrients – negative points category (fruit, vegetable, and nut content, walnut and olive oil, fiber, and protein content). The score for category C nutrients is then subtracted from the score for category A nutrients to generate the final nutrient score of the cooked sausage. Each nutrient/food component in category A nutrients can be awarded a maximum of ten points, while each nutrient/food component in category C nutrients can be awarded a maximum of five points. Once the final nutrient scores are obtained, they are compared with the cut-off values for the color-coded food grades from A to E. The score is determined on a scale that ranges continuously from < -1 (e.g. water), which represents the healthiest option, to +40, which represents the least healthy option (Figure 1). It is important to emphasize that if a meat product achieves a total score of 11 points or higher in category A, the deduction of negative points for protein will only occur if the product also obtains a score of 5 points or higher in other components of category C, such as fruit, vegetables, or fiber content.

These calculations were made by taking available information on nutritional labels from the products packages provided by manufacturers and required by *Official Gazette of RS (23/2022)* (which are in accordance with *Regulation (EU) No. 1169/2011* of the European Parliament and the Council on the provision of food information to consumers). This information included: energy (kJ/100g), total fats (g/100g), saturated fatty acid content (g/100g), total carbohydrate content (g/100g), protein content (g/100g), salt content (as NaCl, g/100g), fiber (if present, g/100g), and fruits, vegetables, pulses, nuts, and rapeseed, walnut and olive oils if present (g/100g). Total sodium content (mg/100g) was calculated using the formula: salt content (g/100g)/2.5*1000.

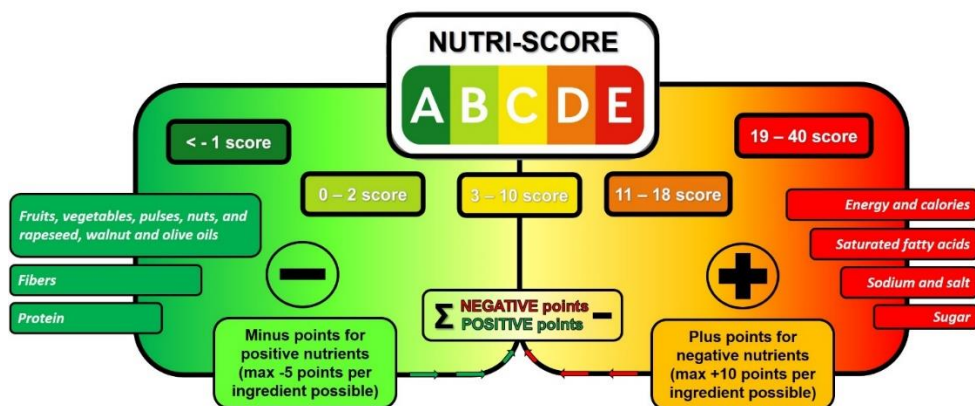


Figure 1. Nutri-score 5-color nutrition labeling system on the front-of-pack label of the products

In summary, when it comes to the nutrient content in 100 g, meat or meat products that are designated with a green label (A or B) are deemed to be of higher nutritional value, while those with an orange/red label (D or E) are regarded as being of lower nutritional quality. Additionally, researchers focused on following the percentage of products carrying Nutri-score in addition to conventional nutritional information.

Furthermore, determining the cumulative average amount of saturated fats consumed on a daily basis through consumption of cooked sausages was performed. Based on the recommended daily intake of 2,000 kcal/day and the guideline stating that no more than 10% of daily kcal should come from saturated fats (EFSA, 2010), it is estimated that a maximum of approximately 22 g of saturated fatty acids (SFA) can be consumed daily to meet this criterion. The calculation for determining total saturated fat intake involved dividing the average saturated fat content in finely and coarsely ground cooked sausages expressed per 100 g of a product by 22 g.

Results and Discussion

Table 1 showcases the summarized results of the color-coded Nutri-scores awarded to cooked sausages obtained from the retail outlets in the area of Belgrade, Serbia.

Table 1. Number of meat products distributed among distinct nutritional grades within groupings of cooked sausages that are commercially available at retail outlets in Belgrade region, Serbia

Cooked sausage group		Total number of samples evaluated	Nutritional grade				
			A	B	C	D	E
Finely ground cooked sausages							
1.	Hot dog sausages	10	-	-	-	5	5
2.	Hot dog-type sausages (products marketed under a different name)	43	-	-	-	35	8
3.	Frankfurter sausages	1	-	-	-	-	1
4.	White sausages	1	-	-	-	-	1
5.	Bologna sausages	1	-	-	-	1	-
6.	Bologna-type sausages (products marketed under a different name)	52	-	-	2	46	4
Total number of finely ground cooked sausages		108	-	-	2	87	19
Total number of finely ground cooked sausages (%)		100	-	-	1.9	80.5	17.6
Coarsely ground cooked sausages							
1.	Mortadella	12	-	-	-	8	4
2.	Srpska sausage	2	-	-	-	-	2
3.	Tirolska sausage	1	-	-	-	-	1
4.	Tirolska-type sausage (under the name of Alpska sausage; products marketed under a different name)	18	-	-	-	11	7
5.	Products marketed under a different name	48	-	-	-	12	36
Total number of coarsely ground cooked sausages		81	-	-	-	31	50
Total number of coarsely ground cooked sausages (%)		100	-	-	-	38.3	61.7
Total number of cooked sausages evaluated		189	-	-	2	118	69
Total number of cooked sausages evaluated (%)		100	-	-	1.1	62.4	36.5

As noted by *Vlassopoulos et al. (2022)*, category C is the considered best possible class for processed meat products that include added animal fats and, with that, higher levels of saturated fatty acids, such as cooked sausages. The Nutri-Score is in line with the principles of the Mediterranean diet and the nutritional guidelines of several European countries, which emphasize moderation in the consumption of animal fats and a preference for certain types of vegetable oils (*Herberg et al., 2021*). According to *Vlassopoulos et al. (2022)*, for meat products, in general, coming from the Greek market, the most common Nutri-Score was D for all subcategories, including sausages, with 57.1% having Nutri-Score D,

and 42.9% having a score E. This observation is in accordance with the results of this research (Table 1), with around a third of the cooked sausages having the Nutri-Score D, while Nutri-Score C was only at 1.1%. Interestingly enough, both products from the Group C came from the same subgroup (Bologna-type sausages, finely ground cooked sausages) and the same manufacturer who reformulated Bologna sausages by adding fiber, hence increasing the positive outcome for the calculated Nutri-Score. *Rašeta et al. (2020)* conducted a study in Serbia that examined a total of 110 meat, minced meat, meat products, and semi-processed meat products available in retail stores in the Republic of Serbia. The calculated Nutri-Scores of these products revealed that approximately 41% were classified as Group D and 41.5% were classified as Group E, with bacon, dried and semi-dried fermented sausages, and coarsely ground cooked sausages contributing almost two-thirds to Group E. Nutri-Scores A (2.9%), B (1.6%) and C (13%) groups were mainly given to the fresh and minced meat, smoked meat products, canned meat chunks and meat dishes and dishes with meat, respectively. From all of the examined finely ground cooked sausages D category was the most prevalent (66.7%), while the rest of the products were categorized as having Nutri-Score E. These results majorly differ from the ones we obtained, as in our research, only 17.6% were in the red zone (E score). Just like the study conducted by *Rašeta et al. (2020)* that investigated the labels of coarsely ground cooked sausages and discovered that 73.3% of products belonged to Group E while only 26.7% belonged to Group D, we also observed that the majority of these products fall under the E category (61.7%), with only 38.3% falling under Group D. In both cases (finely and coarsely ground sausages), the results may differ because of the two reasons – first being the difference in a total number of examined products of these type (60 vs. 188), and second that could indicate that shifts are slowly being made in the meat industry in Serbia towards creating healthier products for the consumers.

It is noticeable that the number of products in the group under the name of „products marketed under a different name” have risen in the last decade compared to the products which are regulated under the names provided by the official classification by the *Official Gazette of RS (50/2019; 34/2023)*. *Kurćubić et al. (2012)* were able to find 14 Srpska sausages on the market, while we were able to find only two. This could be attributed to the newer legislation of Srpska sausage, which, unlike the previous versions of this document *Official Gazette of RS (94/2015; 104/2015; 19/2017)* had much fewer demands surrounding the composition of this product. Nevertheless, since the composition of Srpska sausage is narrowly defined by the Rulebook (as it is a product made from pork meat, namely: 20% meat emulsion, (prepared as 40% meat, 40% solid fatty tissue, and 20% water), and 80% minced pork meat and fatty tissue in which the proportion of meat is 80%, and solid fat tissue 20%, salt, nitrites, phosphates, antioxidants, and defined spices), improving the Nutri-score of Srpska sausages cannot be achieved

easily since it contains, by default, large quantities of fat content (> 20%), and hence high content of saturated fatty acids and energy (kJ/100 g) which are two of five contributors to plus points leading to “bad” nutritional score. Moreover, according to *Dorđević et al. (2017)*, Srpska sausage has the great potential to receive protection from The Intellectual Property Office of the Republic of Serbia through trademark registration as well as the indication of geographical origin s.c. “Serbian quality” trademark. The introduction of an EU evaluative label, such as Nutri-Score, on traditional products is viewed by certain individuals as a potential threat to the authenticity of these products and to the preservation of cultural customs. The European Union acknowledges several types of “quality products” that are safeguarded by schemes like the protected designation of origin, protected geographical indication, or traditional specialty guaranteed. These schemes aim to preserve and promote the unique characteristics of specific products that are linked to their geographical origin and traditional knowledge passed down through generations (*European Commission, 2020; Delhomme, 2021*). However, these types of products usually have a tendency to be high in energy and frequently contain high amounts of fat, salt, or sugar. In Serbia’s case, this would mean that Srpska sausage, due to its formulation, will always be considered in the most undesirable Group E, similar to Italian Parma ham. Critics of Nutri-Score argue that implementing the system may create a market divide between “traditional products” that are challenging, if not impossible, to reformulate due to their legal composition specifications, and are therefore considered non-healthy foods (*European Commission, 2020; Delhomme, 2021*). Modifications in recipes by manufacturers to enhance the Nutri-Score could potentially lead to an amplified use of additives aimed at preserving taste and texture and prolonging the product's shelf life. Nonetheless, these additives are not taken into consideration when calculating the Nutri-Score. This could misguide consumers in the way that “processed foods,” which can be easily subjected to the reformulation process, could be preserved as „healthy foods” (*Fedde et al., 2022*).

The categorization of cooked sausages as predominantly unhealthy can be attributed to the inherent characteristics and formulations of the meat products themselves (Figure 2). Reducing components that largely contribute to “bad” Nutri-score through recipe corrections is an essential task that the meat processing industry, paired with the newest scientific knowledge, consistently tackles along.

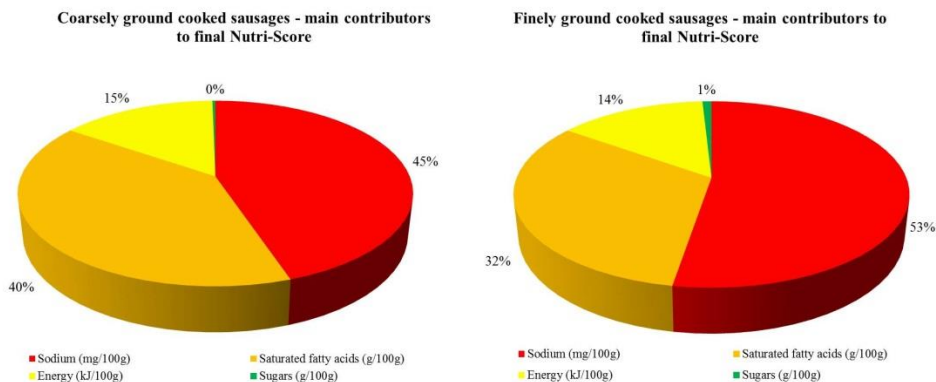


Figure 2. Major Nutri-score contributors of finely and coarsely ground cooked sausages

As shown in Figure 2, the need to reduce sodium and saturated fatty acids in meat products is crucial, given that cooked sausages are often categorized as "unhealthy foods" due to the significant presence of these components. In a previous study conducted by *Stamenić et al. (2021)*, it was highlighted that the reduction of sodium content is necessary for various categories of meat products, as the findings revealed that certain samples contained sodium chloride levels that approached the upper limit of the World Health Organization's recommended daily salt intake (5 g/day) per 100 g of meat product. Sodium chloride content among finely ground cooked sausages varied from 2.08 ± 0.36 g/100 g (expressed as $X_{sr} \pm S_d$), whereas the average amount of NaCl found on nutritional labels as provided by manufacturers in coarsely ground cooked sausages was 2.27 ± 0.48 g/100 g of product. The saturated fatty acid (SFA) content emerged as another significant nutritional parameter of concern. Multiple studies provide evidence of a positive association between the consumption of specific foods, particularly those high in cholesterol and SFA like meat products, and the incidence of various diseases such as cardiovascular diseases, dyslipidemia, obesity, and more (*Simopoulos, 2016; Patel et al., 2022*). As a result of these findings, the need to create new recommendations on fat intake has developed. Organizations such as the World Health Organization (*WHO, 2003*), and the European Food Safety Agency (*EFSA, 2010*) suggest an optimal intake (for healthy adults) of total fat that constitutes 20-35% of the total daily energy input (average Dietary Reference Intakes for healthy adults is 8400kJ/day or 2000 kcal/day), whereby less than 10% of energy should come from saturated fatty acids. In finely ground cooked sausages, the average SFA content was calculated to be 6.00 ± 2.29 g/100 g of products. Out of 108 products analyzed, nine of them (of which five belonging to the category of hot dog sausages) contained ≥ 10 g of SFA per 100 g of meat product. Similarly, for coarsely ground cooked sausages, the results indicated a variation in SFA content of 8.54 ± 0.48 g/100 g of products, with 19 products containing ≥ 10 g of SFA per

100 g of meat product. Cumulative average amount of saturated fats consumed on a daily basis through consumption of finely ground cooked sausages was calculated to be contributing from 17 – 40%/100 g of consumed product, with a maximum reaching 13 g of SFA/100g contributing with 65% of maximum recommended SFA daily intake. Similarly, for coarsely ground cooked sausages, the results indicated a variation in SFA content of 8.54 ± 0.48 g/100 g of products, with 19 products containing ≥ 10 g of SFA per 100 g of meat product, contributing to 37 – 41 % of maximum recommended SFA daily intake. Furthermore, the highest SFA content observed in this group of products was 14 g per 100 g of consumed cooked sausage, contributing to a substantial 67% of the maximum recommended daily intake of SFA.

Conclusion

The utilization of Nutri-Score and Front-of-Pack labels is not widely adopted in the food retail industry of the Republic of Serbia, particularly within the meat processing industry. Since the application of the Nutri-score represents a voluntary initiative of manufacturers, it does not come as a surprise that only 8 products, all coming from one large food retailer chain – Delhaize Serbia, including its two retailer-branded trademarks (Maxi and Premia) of the 189 examined pre-packaged cooked sausages had Nutri-Scoring scheme on the Front-Of-Pack label. The manufacturers' limited adoption of Front-Of-Pack labels and Nutri-Score on meat products can be attributed to various factors, including the additional resource requirements associated with implementing such labeling. Given that the adoption of the Nutri-Score system in EU countries represents a significant measure in facilitating consumer choices towards healthier options, the Serbian domestic meat industry must undertake targeted and dedicated endeavors to enhance the production of cooked sausages. This urgency arises from the fact that a substantial 98.9% of retail cooked sausages were categorized within Groups D and E (falling in the dark orange and red zones) according to the Nutri-Score method, signifying their classification as unhealthy. The meat industry is recommended to focus on adopting newer technological solutions and giving special consideration to reducing the levels of challenging nutritional aspects, such as sodium, saturated fatty acid content, and overall energy balance in meat products like finely and coarsely ground cooked sausages, which offer great potential for nutritional score enhancement through relatively straightforward reformulation methods. To date, as to the authors' knowledge, no survey has been conducted in Serbia regarding consumers' attitudes towards Front-of-food labeling and incorporation of the Nutri-Score scheme and its impact on their decision-making process when purchasing products.

Nutritivna evaluacija barenih kobasica dostupnih na tržištu Republike Srbije primenom nutri-score metodologije

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Rezime

Poboljšanje nutritivnog kvaliteta hrane predstavlja priznatu strategiju u cilju prevencije hroničnih nezaraznih bolesti (HNB), i predstavlja jedan od primarnih fokusa politike javnog zdravlja širom sveta. Nutri-skor predstavlja logo lociran na prednjoj strani pakovanja i predstavlja kombinaciju boja i slovnih obeležja (A, B, C, D, E), pri čemu služi kao sredstvo za pomoć potrošačima za brzu identifikaciju zdravijih alternativa u okviru iste grupacije hrane. Ima pozitivan uticaj u smislu svesti potrošača, percepcije, razumevanja i ponašanja prilikom kupovine i potencijalno doprinosi smanjenju prevalencije HNB. Cilj ovog istraživanja je bio da se proceni nutritivni skor fino i grubo usitnjenih barenih kobasica dostupnih na tržištu Srbije. Analizirano je ukupno 189 upakovanih barenih kobasica iz osam najvećih lanaca supermarketa u beogradskom regionu Republike Srbije. Barene kobasice su ocenjene primenom metodologije Nutri-skor sistema i shodno tome, smeštene u odgovarajuće kategorije. Rezultati skrininga tržišta su ustanovili da samo 1,1% barenih kobasica spada u Nutri-skor grupu C, dok je 62,4% klasifikovano u grupu D, a 36,5% u grupu E. Smanjenje natrijuma i zasićenih masnih kiselina, činioca koji u najvećoj meri doprinose nepovoljnim nutritivnim karakteristikama barenih kobasica, predstavlja ključni korak usled njihovog značajnog prisustva u ovim proizvodima koja dovodi do njihovog obeležavanja kao „nezdrave hrane“.

Ključne reči: nutritivni skor, deklarisanje namirnica, barene kobasice, zasićene masne kiseline

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