Comparative Study on the Nutritional Label and Ingredients List of Pork Sausages Produced in a Conventional System

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Abstract

In Romania, the consumption of pork-based products ranks high among consumer preferences, primarily because they often do not require prior thermal processing. Their consumption provides the necessary energy and nutrients needed by a person throughout the day.

A total of 18 types of pork sausages produced in a conventional system were studied (including 6 types each of Oltenian sausages, Cabanos, and Sticks). The study aimed to analyze the list of ingredients used in their production and the nutritional labels, with a particular focus on salt and protein content, as well as the proportions of fats and carbohydrates. The study also assessed whether the labels comply with current legislation on product labeling and the application of hygiene standards regarding the use of food additives.

The study found that Oltenian sausages contained salt in the range of 0.8-2.9 g, protein between 14-18 g, fat content between 13-28.93 g, and carbohydrates between 1-4.3 g. The Cabanos sausages had a salt content ranging from 1.70-3 g, protein content between 14-16 g, fat content from 21-29.79 g, and carbohydrates from 0-1.59 g. Sticks sausages showed a salt content between 3.15-4.7 g, protein content from 18-37 g, fat content from 29-47 g, and carbohydrates between 1.3-7.8 g. Although sodium nitrate was found in almost all analyzed products, some types of pork sausages also showed an additional salt intake. No unauthorized food additives, as per current legislation, were identified.

Keywords: label, pork sausages, ingredients

1. Introduction

Industrial pork sausages are characterized by a specific production technology and the ingredients used, resulting in a more uniform consistency, longer shelf life, and a more standardized taste compared to traditionally produced sausages [1-3]. They are made from fatty meat and are seasoned with garlic, salt, pepper, paprika, and various other spices [1, 2]. In industrial production, the process is optimized to produce large quantities while ensuring consistency in taste and texture. This is achieved through the use of additives that extend the product's shelf life and maintain its fresh appearance [4, 2, 5].

The additives used in the production of sausages include nitrates and nitrites, thickening agents, emulsifiers, stabilizers, artificial flavors, taste enhancers, and preservatives [4, 6-8]. The most commonly used flavor enhancer in the analyzed pork sausages is monosodium glutamate (MSG, E621), an additive known for its role in creating a craving for consumption [4, 5, 9, 10].

Nitrates and nitrites used in the production of industrially processed pork sausages serve as preservatives and help maintain the product's color [11, 12]. Sodium nitrite (E250) is the most commonly used preservative found in the studied pork sausages. It is a chemical preservative derived from sodium nitrate, but it can also be sourced from natural deposits, as it exists in nature as a mineral

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[4-13]. The consistent texture of industrially produced sausages is achieved through the use of emulsifiers and thickening agents [14, 15]. Stabilizers play a role in preventing the separation of fats within the meat, while preservatives extend the product's shelf life [1, 2].
Additionally, smoking and drying are other methods used to preserve pork sausages, while also imparting a distinctive flavor. This process is carried out in specialized chambers where temperature and humidity are strictly controlled.
The purpose of the study was to evaluate, through comparison, the nutritional labels of various brands of pork sausages and to analyze the list of ingredients and additives used. This aimed to understand the level of processing in the products and its impact on consumer health [16].

2. Materials and methods

The study was based on analyzing the labels of pork sausages concerning their salt, protein, and fat content. It included 18 varieties of pork sausages (6 varieties each of Oltenian sausages, kabanos, and sticks), produced industrially and available on the market in Iași Municipality.
The analysis of pork sausage labels was carried out by examining the nutritional information and the ingredient list, through a comparison between different brands. This method of analysis helps in identifying high-quality products and avoiding those high in food additives [6, 11, 14, 15].
The study of nutritional labels and ingredient lists

for the 18 types of pork sausages available in stores in the city of Iași was conducted in accordance with the requirements of EU Regulation No. 1169/2011, as well as Regulation No. 1129/2011. The nutritional content values analyzed were taken directly from the product labels and were not validated through laboratory testing.
To analyze the data collected from the product labels, Microsoft Excel software was used, with which the means and standard deviations were calculated. The pork sausages were selected solely based on their availability in stores in the city of Iași, and no criteria such as price, brand, manufacturer, or weight were applied. This study approach aimed to reflect the consumer perspective regarding what the market has to offer

3. Results and discussion

The 6 varieties of Cabanos sausages analyzed had a salt content ranging from 1.70 to 3 grams per 100 grams of product. The sausages produced by the Marcel brand showed the highest salt content (3 grams), compared to other brands, where the salt content ranged from 1.70 to 2.5 grams. Figure 1 illustrates the amount of salt indicated on the labels of pork sausages sold by different brands.

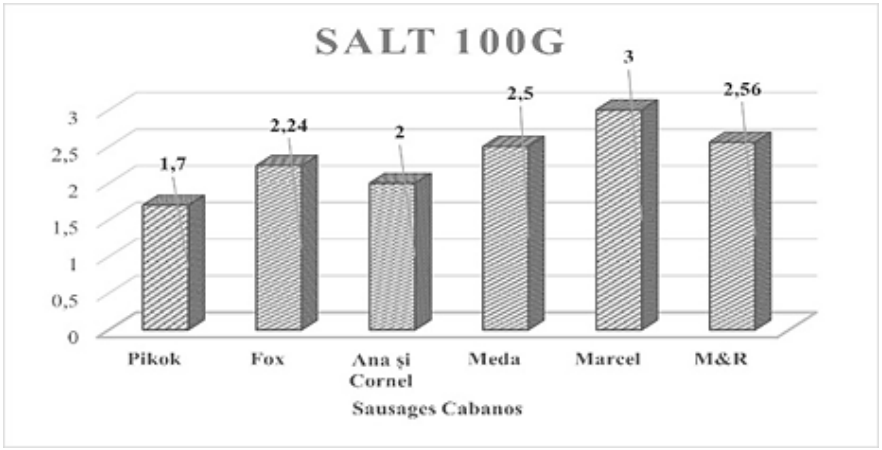

Figure 1. The salt content of Cabanos sausages

The protein content varies between 14 and 16 grams per 100 grams of sausages. The Ana și Cornel and Marcel brands have the highest protein content (16 grams), while the lowest protein content is found in Meda sausages. Figure 2 graphically illustrates the protein content of Cabanos sausages.

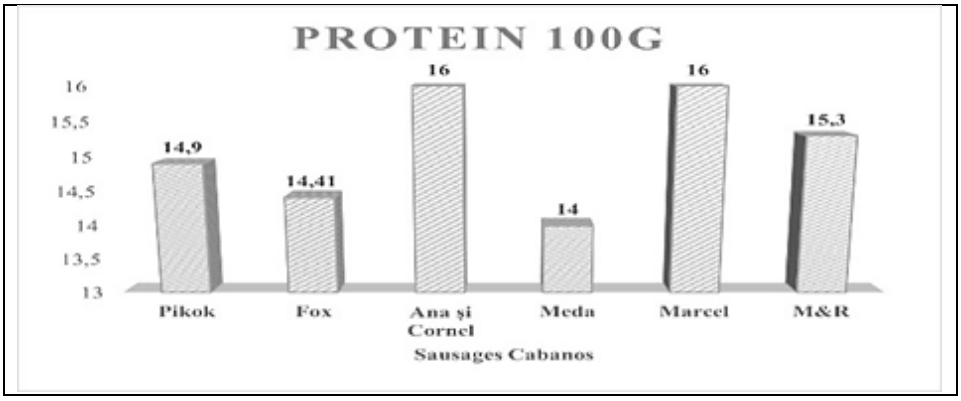

Figure 2. Protein Content in Cabanos Sausages

The fat content in Cabanos sausages ranges from 21 to 31 grams per 100 grams of product. Meda sausages have the highest fat content, specifically 31 grams, of which 11 grams are saturated fatty acids. Figure 3 highlights the amount of total fat and saturated fatty acids as indicated on the labels of the 6 studied brands.

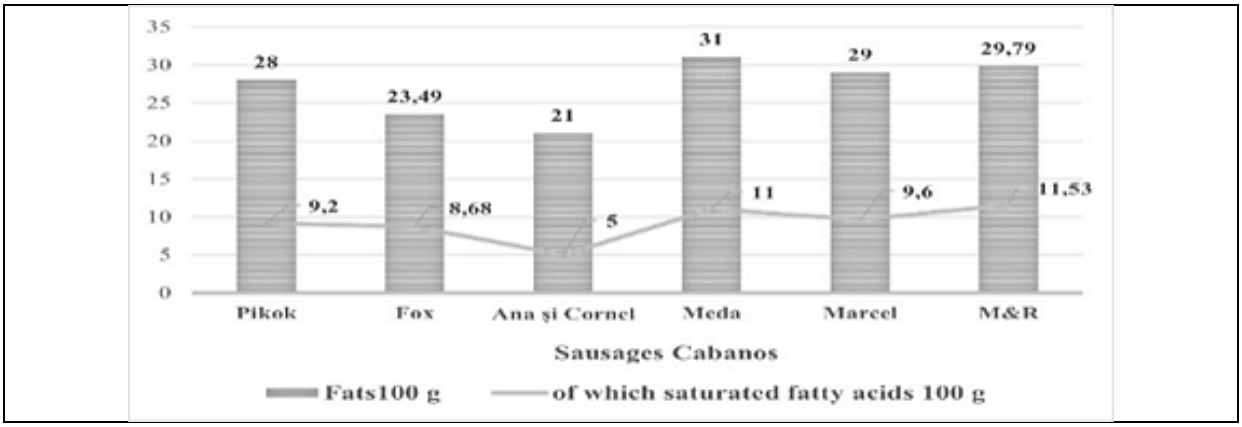

Figure 3. Fat and Saturated Fatty Acid Content in Cabanos Sausages

Carbohydrates are listed on the labels of Cabanos sausages in amounts ranging from 0 to 1.59 grams per 100 grams of product, with sugars accounting for 0 to 1.43 grams. The M&R and Fox brands contain 1.59 grams of carbohydrates, of which sugars make up 1.43 grams and 1.54 grams, respectively, with sugars found in an amount of 0.59 grams. Pikok sausages do not contain carbohydrates or added sugars. Figure 4 illustrates the carbohydrate content as indicated on the nutritional labels of Cabanos pork sausages.

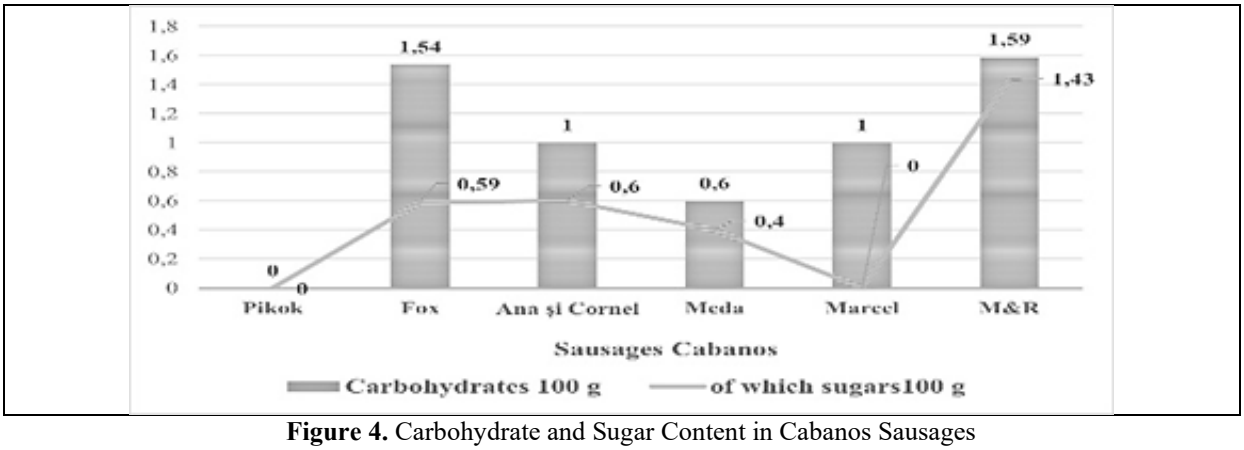

Figure 4. Carbohydrate and Sugar Content in Cabanos Sausages

Additionally, the ingredient list of Cabanos sausages was analyzed to identify the number of additives used. Figure 5 shows the number of E-(food additives) used in Oltenian pork sausages by each manufacturer.

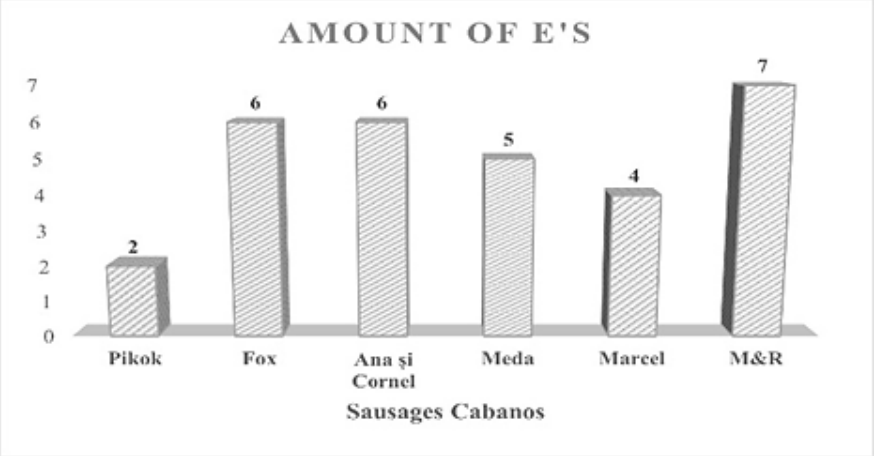

Figure 5. Number of E-Numbers in Cabanos Sausages

From Figure 5, it can be observed that the M&R brand contains the highest number of E-numbers, followed by the Ana și Cornel and Fox brands. Pikok sausages contain only 2 additives, which classifies the product as having a clean label.

The most commonly used additive in Cabanos sausages is sodium nitrite (E250), which serves as a preservative and appears on the label of all the brands studied.

Also listed in the ingredients are sodium diphosphates (E450i), sodium triphosphates (E450ii), and sodium polyphosphates (E451). In addition to these, there are thickening agents (E407), antioxidants (E316, E300, E301), flavor enhancers (E621, E627, E631), colorants (E120), sugars (dextrose, sugar, maltodextrin), and acidity regulators (E575). The thickening agent (E407) is found on the labels of the Fox and Ana și Cornel brands. Antioxidants (E316 – sodium isoascorbate, E300 – ascorbic acid, E301 – sodium ascorbate) are present on the labels of Fox sausages (E316), Ana și Cornel (E300), Meda (E301, E301), Marcel (E301), and M&R (E316). Flavor enhancers (E621, E627, E631) are listed on the labels of M&R sausages (E621, E627, E631) and Ana și Cornel (E621). The acidity regulator, E575, appears on the ingredient list of Ana și Cornel sausages.

Sugars, in the form of dextrose, sugar, and maltodextrin, are found on all the labels analyzed, except for Pikok. It was noted that, although sodium nitrite appears on the ingredient list of all Cabanos sausages, some brands (Ana și Cornel, Meda, Marcel, M&R) also mention salt.

The protein content in the studied Cabanos pork sausages primarily comes from soy protein, with the exception of the Pikok and Ana și Cornel brands.

Another variety of sausages analyzed for nutritional labeling and ingredient lists is Oltenian sausages. The labels of 6 sausage brands were studied. In terms of salt content, Ana și Cornel Oltenian sausages rank first, containing 2.9 grams of salt, followed by Matache Măcelarul sausages with 2.71 grams of salt.

The lowest amount of salt is found in Caroli sausages, specifically 0.8 grams. Figure 6 illustrates the salt content in each type of Oltenian sausage studied.

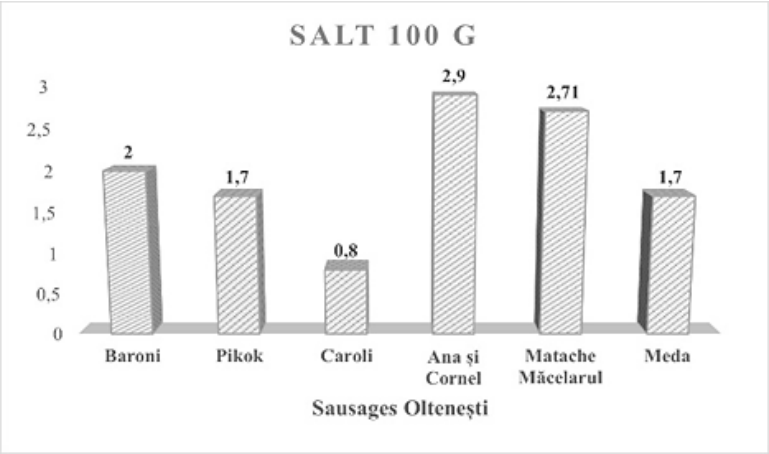

Figure 6. Salt Content in Oltenian Sausages

Pikok and Caroli sausages have the highest protein content, with 18.7 grams and 19.5 grams, respectively, while Ana și Cornel sausages have the lowest protein content, with 14 grams. Additionally, the protein content of each analyzed brand can be seen in Figure 7.

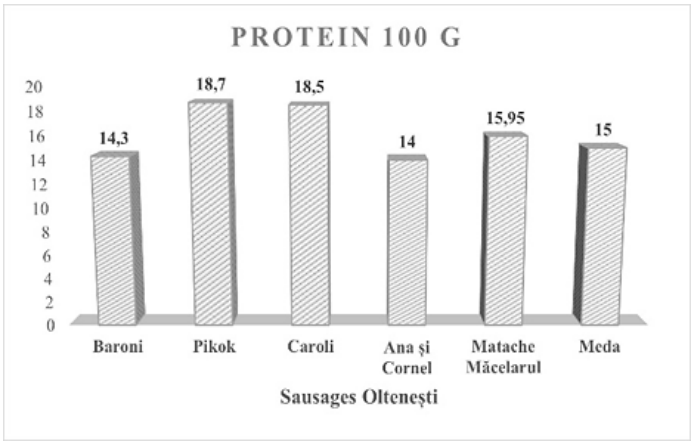

Figure 7. Protein Content in Oltenian Sausages

The evaluated Oltenian sausages have a fat content ranging from 13 to 28.93 grams, of which saturated fatty acids make up 6.4 to 12.03 grams, showing a considerable difference. Caroli sausages are the lowest in fat (13 grams), while Matache Măcelarul sausages are the highest, containing 28.93 grams. The fat content of each product is highlighted in Figure 8.

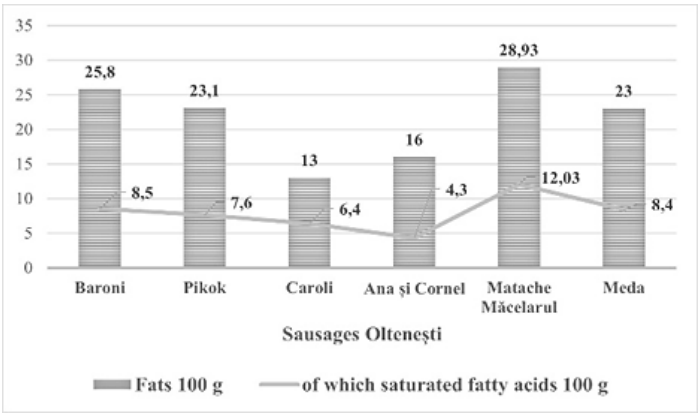

Figure 8. Fat and Saturated Fatty Acid Content in Oltenian Sausages

Carbohydrates are present in Oltenian sausages in amounts ranging from 0 to 3.4 grams, with sugars accounting for 0 to 2.2 grams. Pikok sausages contain no added carbohydrates, while Ana și Cornel sausages have an addition of 3.4 grams, with 2.2 grams being sugars. The other studied brands have carbohydrate content between 1.0 and 1.86 grams, with sugars ranging from 0.5 to 1.2 grams. Caroli and Baroni sausages contain 1 gram of carbohydrates, with 0.5 and 0.7 grams of sugars, respectively. Figure 9 illustrates the carbohydrate and sugar content in Oltenian sausages.

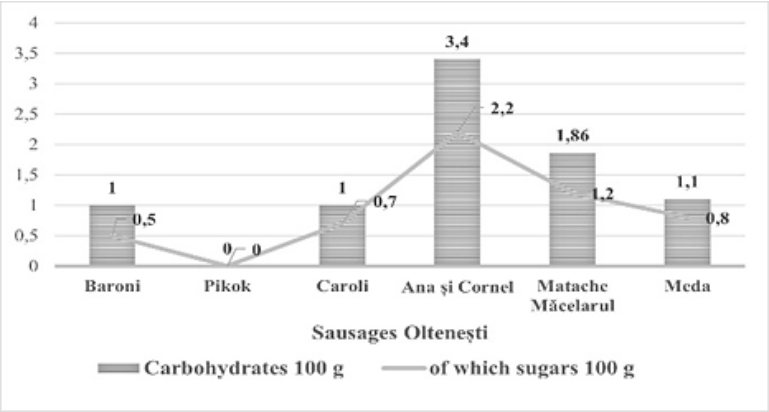

Figure 9. Carbohydrate and Sugar Content in Oltenian Sausages

The ingredient list includes, in addition to the salt and carbohydrate content (sugars, maltodextrin), food additives with roles in preservation, thickening, antioxidant action, and flavor enhancement. The same food additives identified in Cabanos sausages were also found in Oltenian sausages, though in smaller quantities. Figure 10 graphically represents the number of food additives in the 6 varieties of Oltenian sausages studied.

Compared to Cabanos sausages, where monosodium glutamate (E621) appears on the label of only one producer, in the case of Oltenian sausages, this flavor enhancer additive is found on the label of two of the analyzed brands (Baroni and Ana și Cornel).

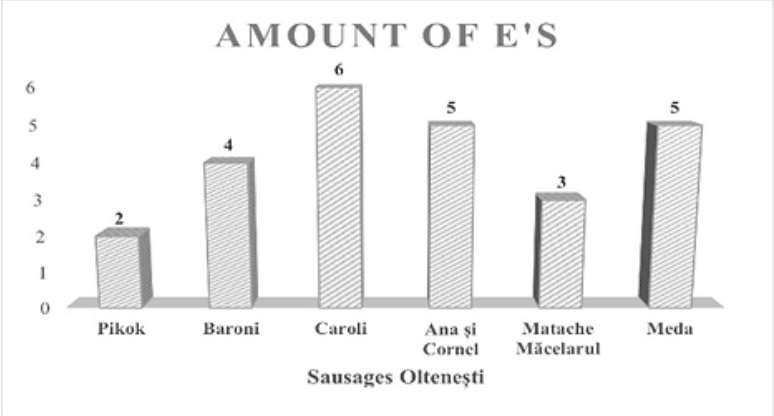

Figure 10. Number of E-Numbers in Oltenian Sausages

Phosphates (E451), used as stabilizers, are found on the label of all Oltenian sausages, except for those produced by Matache Măcelarul, which contain diphosphates (E450). The other brands do not contain diphosphates, in contrast to Cabanos sausages, which contained both diphosphates and triphosphates. Antioxidants such as erythorbic acid (E315), ascorbic acid (E300), and sodium isoascorbate (E316) are listed on the labels of Baroni sausages (E315), Caroli (E300), Matache Măcelarul (E300), Meda (E301), and Ana și Cornel (E316).

Similarly, salt appears on the ingredient list of Oltenian sausages, even though they also contain sodium nitrite. Soy protein is mentioned in the

ingredient list of Caroli sausages. The Caroli and Meda brands also include mentions of vegetable fibers and hydrolyzed vegetable protein. Sugars are listed on the labels of Oltenian sausages, except for the Pikok brand. The Sticks sausages are the final variety of sausages analyzed for their label. Six varieties of Sticks sausages were examined regarding their nutritional labels and ingredient lists.

The lowest salt content is found in Cris-Tim sausages, with exactly 2.98 grams. In Carrefour brand sausages, the salt content is 4.7 grams. For the other analyzed brands, the salt content ranges from 3.15 to 4 grams. Figure 11 shows the salt content in Stick sausages for each analyzed brand.

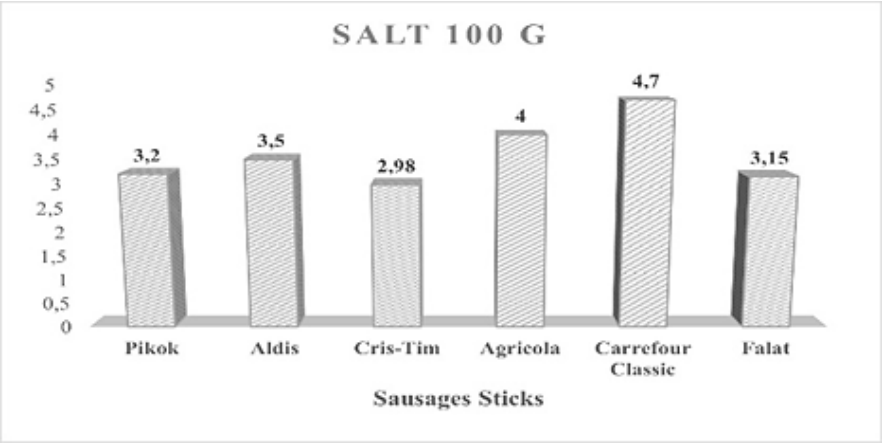

Figure 11. Salt Content in Sticks Sausages

Although Carrefour Classic sausages have the highest salt content, it is also noted that they have the highest protein content (37 grams). The lowest protein content is found in Aldis and Agricola sausages. Figure 12 illustrates the protein content in each type of sausage studied.

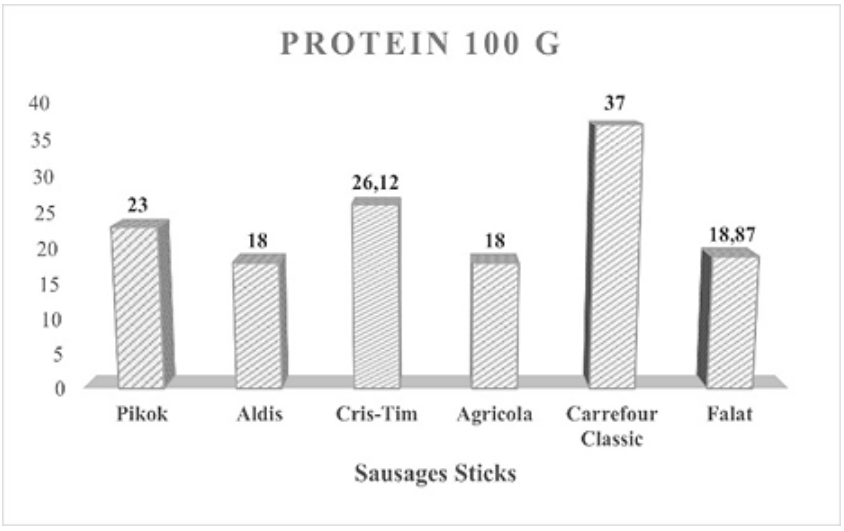

Figure 12. Protein Content in Sticks Sausages

Regarding fat content, Agricola sausages list 47 grams of fat on the label, of which 16 grams are saturated fatty acids. Aldis, Falat, and Cris-Tim sausages contain between 40 and 41.59 grams of fat, with saturated fatty acids making up 4.7 to 9.73 grams. For each sausage brand analyzed, the fat content and saturated fatty acids are highlighted in Figure 13.

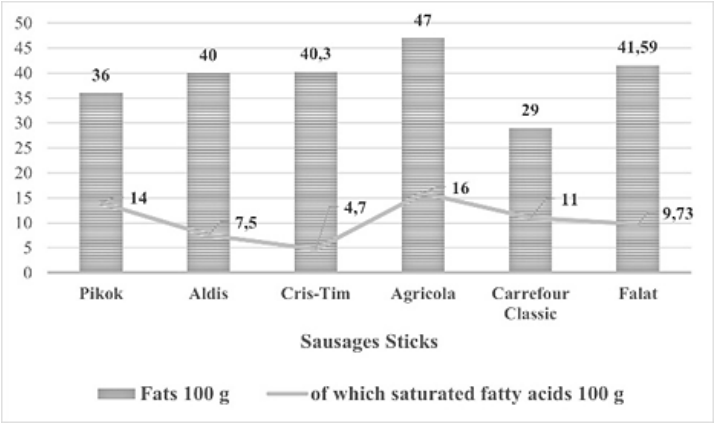

Figure 13. Fat and Saturated Fatty Acid Content in Sticks Sausages

Unlike Cabanos and Oltenian sausages, where the Pikok brand did not contain carbohydrates or added sugars, in this case, Pikok registers the highest carbohydrate content, with 7.8 grams, of which 2.2 grams are sugars. The next brand with the highest carbohydrate content is Agricola, with 6 grams, of which 2.4 grams are sugars.

Figure 14 highlights the carbohydrate and sugar content in Sticks sausages.

Regarding the ingredient list and food additives content, the Carrefour Classic and Falat brands do not mention the presence of any additives. There is a mention of salt content, but not of sodium nitrite.

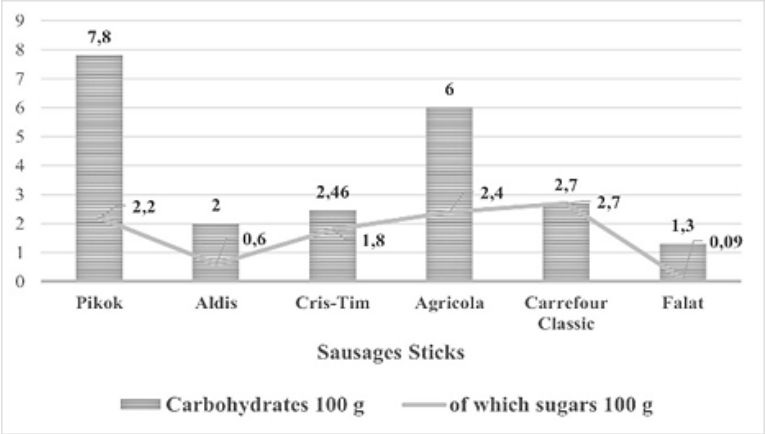

Figure 14. Carbohydrate and Sugar Content in Sticks Sausages

Carrefour Classic sausages also mention the use of dextrose. The Pikok brand contains a total of 9 food additives, namely: calcium lactate (E327), sodium acetates (E262), sodium citrates (E331), monosodium glutamate (E621), sodium erythorbate (E316), sodium nitrite (E250), sodium alginate (E401), cellulose (E461), and calcium chloride (E509). Cris-Tim sausages contain vegetable protein from peas, while Aldis and Agricola sausages contain vegetable protein from soy, with the note that Agricola uses non-GMO soy. Sodium alginate, calcium lactate, and sodium nitrate are found on the labels of Aldis and Cris-Tim sausages. Ascorbic acid is present in Cris-Tim and Agricola sausages, while sodium erythorbate appears in Aldis sausages. Aldis uses carmine, a natural food coloring, while Agricola uses beetroot extract. All analyzed brands contain carbohydrates, represented by dextrose and maltodextrin. Starter cultures are present in Aldis sausages. The quantity of E-numbers in each analyzed brand is shown in Figure 15.

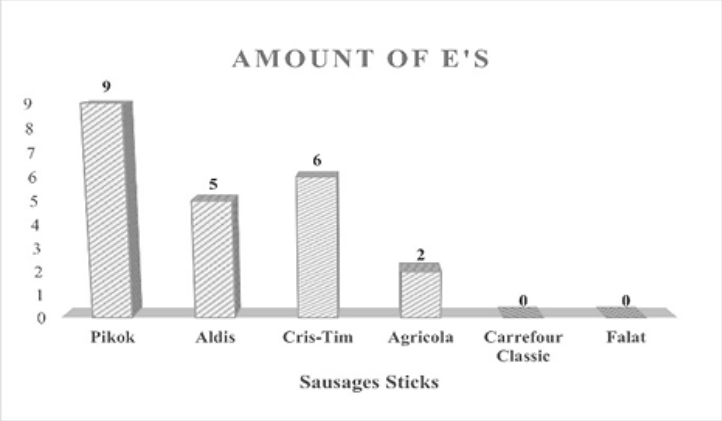

Figure 15. Number of E-numbers in Sticks Sausages

Based on the data obtained from the analysis of the labels of conventionally produced pork sausages, it can be concluded that the Sticks variety has the highest average salt content, with a mean value of 3.59 g±0.77 g/100 g (standard deviation), followed by the Cabanos sausages with 2.17 g±0.49 g/100 g, and the Oltenian variety with 1.97g±0.65g/100g. The mean salt content, standard error, and standard deviation for each product category are presented graphically in Figure 16.

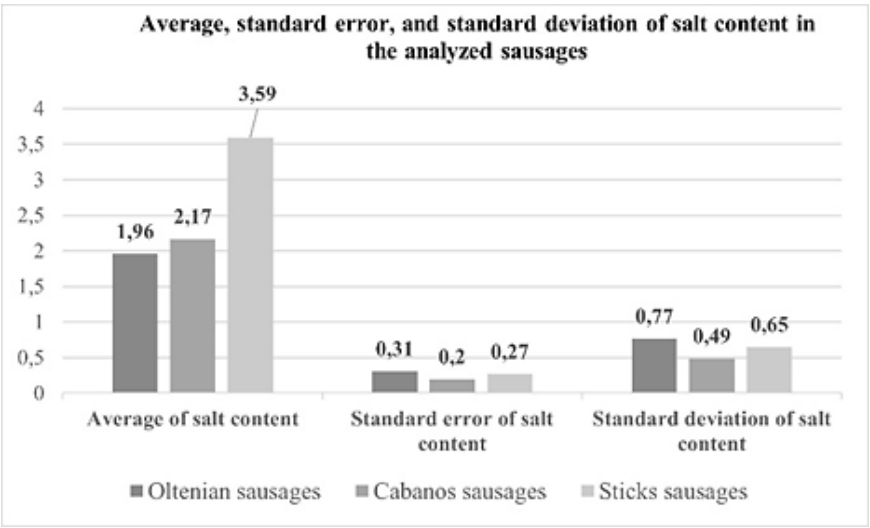

Figure 16. Variation in the salt content of the analyzed pork sausages

The highest protein content was recorded in the "Sticks" sausages, with a mean value of 16.08 g±2.07 g/100 g (standard deviation), followed by the Oltenian sausages, which also reported a mean of 16.08 g±2.07 g/100g.

The lowest protein content was observed in the Cabanos sausages, with an average of 15.10 g±0.82 g/100 g. The calculated values for the mean, standard error, and standard deviation are graphically represented in Figure 17.

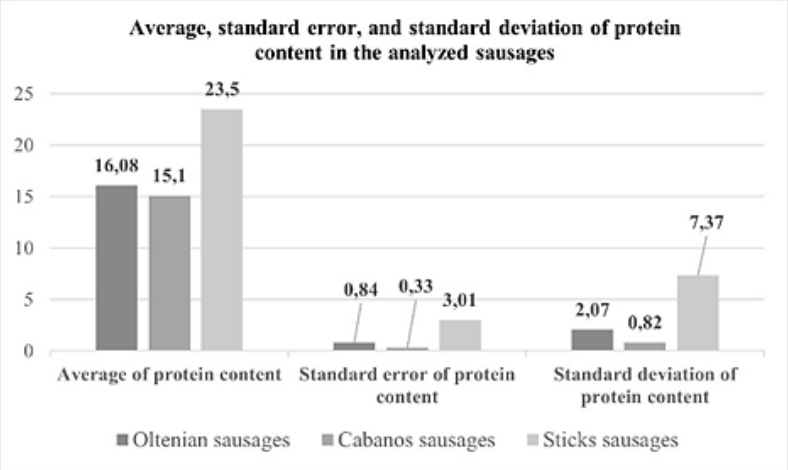

Figure 17. Variation in the protein content of the studied pork sausages

Regarding fat content, the Sticks sausages contain 38.98 g±6.04 g/100 g (standard deviation), with a mean saturated fatty acid content of 10.49 g ±4.15g/100 g. They are followed by the Cabanos sausages, which have an average total fat content of 27.05 g±3.93 g/100 g and a mean saturated fat content of 9.07 g±2.31 g/100 g. The Oltenian sausages have the lowest total fat content, with 21.64 g±6.02 g/100 g, and a mean saturated fatty acid content of 7.87 g±1.05 g/100g. These variations are graphically represented in Figure 18.

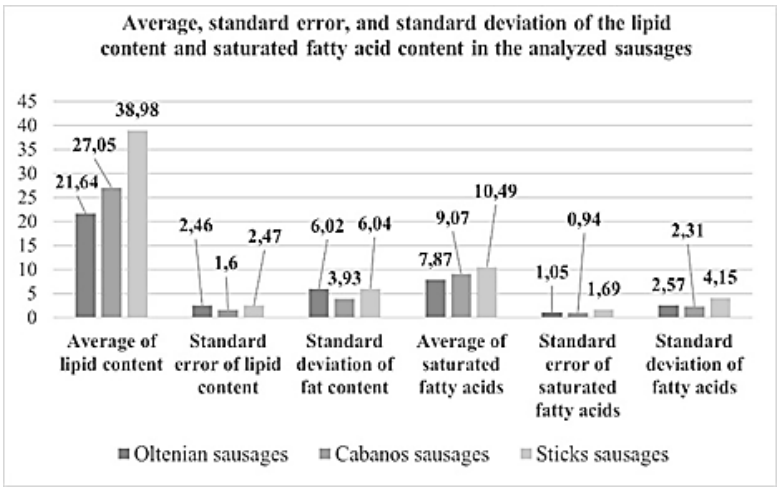

Figure 18. Variation in fat content and saturated fatty acid levels in the analyzed pork sausages

The highest carbohydrate content was also found in Sticks sausages, with a mean value of 3.71 g±2.58 g/100 g (standard deviation). The sugar content in this product was 1.63 g±1.05 g/100 g. Oltenian sausages had an average carbohydrate content of 1.39 g±1.15 g/100 g and a mean sugar content of 0.9 g±0.75 g/100 g. The lowest carbohydrate content was observed in Cabanos sausages, with a mean of 1.02 g±0.57 g/100 g, and a mean sugar content of 0.54 g±0.53 g/100 g (standard deviation). The calculated values for the mean, standard error, and standard deviation are presented in Figure 19 in the form of a diagram.

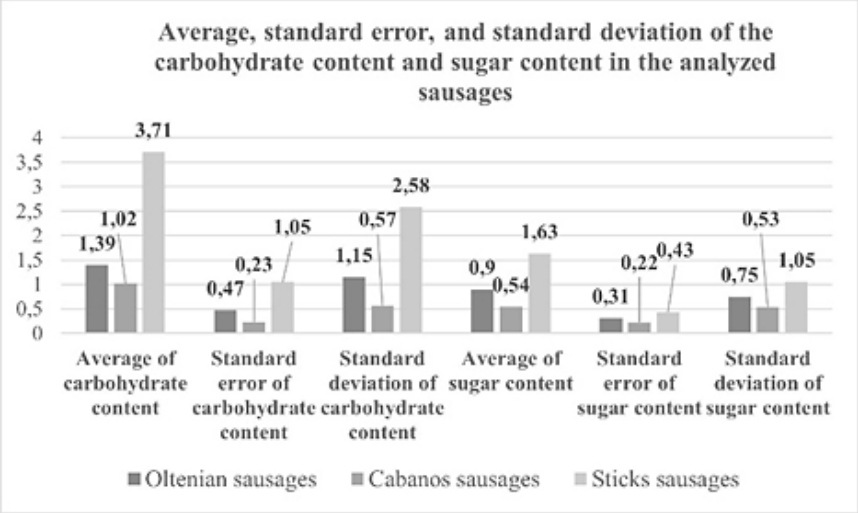

Figure 19. Variation in the carbohydrate and sugar content of the studied pork sausages

4. Conclusions

In terms of salt content, Cabanos sausages contain between 1.7 and 2.5 grams, Olteneşti sausages between 0.8 and 2.9 grams, and Sticks sausages between 3.2 and 4.7 grams, all reported per 100 grams of sausages.

It is noteworthy that Sticks sausages have the highest salt content. Additionally, both Cabanos and Olteneşti sausages, in addition to salt, also contain sodium nitrate, a food additive used for preservation. According to the World Health Organization, the maximum allowed salt content for meat products is 0.5 grams per 100 grams of product. Based on the nutritional label analysis, it can be concluded that the analyzed products exceed this recommended amount, raising concerns regarding consumer health.

Protein content in Cabanos sausages ranges from 14 to 16 grams, in Olteneşti sausages between 14 and 18.7 grams, and in Sticks sausages between 18 and 37 grams per 100 grams of product. In this case, Sticks sausages have the highest protein content.

The current legislation states that plant proteins from soy or peas cannot completely replace meat, and their use in pork sausages is allowed in a proportion of 5-30% of the total ingredient quantity.

It is also noted that some brands use plant protein from soy (either genetically modified or not) or from peas.

As for fats, Cabanos sausages contain between 21 and 31 grams of fat, with saturated fatty acids ranging from 5 to 11.53 grams per 100 grams; Olteneşti sausages have between 13 and 28.93 grams of fat, with saturated fatty acids ranging from 4.3 to 12.03 grams per 100 grams; and Sticks sausages contain between 36 and 41.59 grams of fat, with saturated fatty acids between 4.7 and 16 grams per 100 grams.

Saturated fatty acids are considered the most harmful fats in food, being responsible for triggering conditions and diseases such as cardiovascular diseases and diabetes. According to Law No. 182/19.08.2020, the maximum allowable content of saturated fats in food products has been set. The law stipulates a maximum of 2 grams of saturated fat per 100 grams of fat content in food products.

Regarding food additives, Cabanos sausages contain between 2-7 additives, Olteneşti sausages, 2-6 additives, and Sticks between 0-9 food additives. The most used additives are sodium nitrate (E250), diphosphates and triphosphates (E450i, E450ii0, ascorbic acid (E300), sodium erythorbate (E316). There are also additives such as calcium lactate (E327), sodium monoglutamate (E621), sodium alginate (E401), calcium chloride (E509), etc.

Taking all the analyzed aspects into consideration, it can be concluded that, on average, Sticks sausages have the highest content of salt, protein, fat, and carbohydrates compared to the Oltenian and Cabanos sausage varieties.

The Oltenian sausage variety has a lower content of salt and fat, and the protein content is similar to that of the Sticks sausages. Cabanos sausages, in terms

of salt and fat content, rank between the other two varieties, with a lower protein content than the Oltenian sausages. Thus, it is concluded that the Sticks sausage variety has the highest nutritional value, Oltenian sausages stand out for their lower salt and fat content, and Cabanos sausages occupy an intermediate position between the other two varieties.

To make the wisest purchasing decision, consumers should consider both the nutritional label and the ingredients list in order to make informed choices that align with their needs. Therefore, if a lower intake of salt and fats is desired, Oltenian sausages may be a suitable option. If a higher protein intake is preferred, Sticks sausages can be chosen, with the mention that they also have a higher salt and fat content.

Consumer categories that wish to limit the intake of products rich in food additives may opt for sausages from the Aldis and Agricola brands, as they use natural colorants.

Hence, checking the nutritional label and the ingredients list is essential for making correct and informed choices.

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