Scientific Papers. Series D. Animal Science. Vol. LXVII, No. 2, 2024
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

QUALITY ASSESSMENT OF SOME ASSORTMENTS OF CHICKEN HOT DOG SAUSAGES

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Abstract

The purpose of this paper was the comparative assessment of the quality of some assortments of chicken hot dog sausages sold in Romania. Two batches of five varieties of hot dog sausages were taken in the study: Caroli, Fox, Cris-Tim, Meda and Pikok/Lidl brand, coded from A to E. Sensory (five-point scale method) and physico-chemical properties were analyzed. Were determined the pH of the products, the content of mineral substances (by calcination at 550°C), the content of water, lipids, proteins, collagen and salt (with the Food-Check infrared spectrophotometer). The results showed very high differences between products in terms of fat content (between 13.5% and 25.1%), the variability was lower for proteins (between 16.6% and 19.3%) and water content (between 55.83% and 66.94%). The salt content had the highest value of 2.83%, exceeding the maximum standard limit, only in the case of C product. The results of the sensory analysis revealed a minimum score for product E (10.63 points/"unsatisfactory product" according to quality standards), compared to product B which obtained the best score among all the analyzed assortments (17.70 points/ "good product").

***Key words**: chicken hot dog sausages, quality.*

INTRODUCTION

Recently, the convenience food has become very popular in the market (Contini et al., 2020). At the same time, there is a trend to reduce the consumption of meat and animal products, and consumers are looking more recently the vegan products that they can use in the traditional way they are familiar with (Rybicka et al., 2024). Such products also include plant-based sausages, which can be used both as part of the main course (a hot dog) and as a snack (Kowalczewski et al., 2024).

Nowadays, the growing understanding of the relationship between diet and food ingredients, and its effect on health (Dos Santos, 2020a), has moved consumers to become more conscious and looking for healthier processed foods (de Carvalho et al., 2020). Therefore, many researchers focused on new approaches to develop meat products with better nutritional characteristics; one of the most employed strategies is the reduction of animal fat, which has an elevated saturated fat level More suitable ingredients, such as dietary fibers and edible oils, have been used as a fat substitute (Câmara et al., 2020; de Carvalho et al., 2020; Felisberto et al., 2015).

Marine and vegetable oils are rich in PUFAs content, and their use has been recommended in a healthy diet (Heck et al., 2019). Usually, oils are incorporated into meat products through pre-emulsions, and, more recently, emulsion gels (EGs) as a more suitable strategy to improve nutritional and technological aspects of meat products (Paglarini et al., 2019).

Dietary fibers have health claims, and important technological properties, such as water/oil holding ability, stabilizer, thickener, and gelling properties (Biswas et al., 2011) to elaborate EGs with suitable qualities (dos Santos et al., 2020). Among the proteins that can be used as a structuring agent to create soft-solid EGs, collagen presents suitable functional properties due to its emulsifying and high gelling properties (Gómez-Guillén et al., 2011).

Besides, some by-products of the meat industry are rich in collagen content, such as pork skin that due the extender and binder characteristics has been used to enhanced meat product quality (de Oliveira Fagundes et al., 2017). The purpose of this paper was the comparative assessment of the quality of some assortments of chicken hot dog sausages sold in Romania.

MATERIALS AND METHODS

In order to characterize the quality of some assortments of chicken hot dog sausages, two batches of five varieties of chicken hot dog were taken in the study: Caroli, Fox, Cris-Tim, Meda and Pikok/Lidl brand, randomly coded from A, B, C, D and E (ten samples/five products of two batches from different manufacturer).

Sensory characteristics were analyzed by tasting, using the scoring method;

The samples were minced preliminarily finely ground and homogenized before analysis using an electric shredder (according to the five different manufacturers). Subsequently, the amounts required by each method were used to run 10 analytical replicates per trait.

The water, proteins and lipids contents were assessed on the Omega Bruins Food-Check Near InfraRed (NIR) spectrophotometer (Bruins Instruments GmbH, Germany); the crude ash content was assessed by furnace muffle calcination in a Nabertherm B180 device (Nabertherm GmbH, Germany) (550°C for 24 h after a preliminary carbonization on Bunsen burner flame) (AOAC, 2000; AOAC, 2005).

The nitrogen-free extract (NFE) was calculated by difference, using the Equation (1).

$$NFE\ (g/100\ g) = 100 - Water - Ash - Proteins - Lipids \quad (1)$$

The gross energy value was calculated via the Atwater Equation (2), which uses the caloric value of each organic matter compound in the analysed matrix (total proteins, lipids, nitrogen-free extract - NFE) (FAO, 2003).

$$GE\ (kcal/100\ g\ meat) = g\ proteins \times 4.27\ kcal + g\ lipids\ 9.02\ kcal + g\ NFE \times 3.87\ kcal \quad (2)$$

Using the ***Tukey*** test, the statistical evaluation of the differences of the means was performed.

The evaluation of the sensory quality of this product was carried out in a sensory analysis laboratory of Iasi University of Life Science by the participation of a group of forty-five students in food engineering, each receiving an individual sheet. Prior to analysis, the samples were brought to a temperature of 18-21°C, according to the provisions of the professional/product standards. The analysis of shape, appearance and color is performed in natural, diffuse light. The appearance and color were examined on the outside of the products, then on the inside, visually; the consistency was analyzed on the outside and then in the products section, with the touch analyzer and by chewing. The odor analysis was performed by simple inspiration. The tasting of the samples was done carefully, without haste, with relaxation breaks of about 2 minutes between the portions of the sample; 5-10 g of product were taken for tasting. Before and after tasting each sample, the tasters rinsed the oral cavity with drinking water to eliminate the remaining taste. The evaluation of each sensory characteristic was performed by comparing with scoring scales of 0-5 points (SP 3196-83), obtaining the total average score for all the characteristics examined by the group of tasters, and by comparing it with a scale from 0 to 20 points for weighted average score obtained after tasting (Table 1). The samples were prepared in the same way for all tasters and distributed in equal quantities, in identical vessels. As a result, the arithmetic mean obtained from the score given by all tasters for each characteristic was taken.

Table 1. Classification of the products in the appropriate quality class according to standards

Total average score	Quality class/grade obtained
18.1…20	Very good
15.1…18	Good
12.1…15	Satisfactorily
7.1…12	Unsatisfactory
4.1…7	Bad
0…4	Adulterated

Examination of sensory characteristics specific to chicken hot dog sausages followed: appearance-color, consistency, taste, smell and global assessment.

The pH value of meat was measured at 24 and 48 h post-slaughter (on chilled samples, at 2-4°C), using the digital pH meter HI99163 (Hanna Instruments Ltd., UK), with a penetration probe. Calibration of the pH meter was performed at 4.0 and 7.0 pH at ambient temperature.

RESULTS AND DISCUSSIONS

The sensory analysis (Figure 1 and Figure 2.) revealed a minimum score for product E (10.63 points/"unsatisfactory product" according to quality standards), compared to product B which obtained the best score among all the analyzed assortments (17.70 points/"good product"). The average score of sensory characteristics determined by tasting highlights differences between products, but not with very high values (Figure 1). The highest average score was obtained for appearance (4.3) for product C and the lowest for consistency (3.50) for product E.

The results of chemical analysis (Figure 3) showed very high differences between products in terms of fat content (between 13.5% and 25.1%), the variability was lower for proteins (between 16.6% and 19.3%) and water content (between 55.83% and 66.94%). The salt content had the highest value of 2.83%, exceeding the maximum standard limit, only in the case of C product.

Evaluating the information presented on the product label, it was observed that only one producer has added vegetable fibers (1.42%, the product B). Even if now consumers avoid saturated fats as much as possible, by processing meat, from a technological point of view the addition of fat is practiced, for examples the fatback (the subcutaneous fat taken from under the skin of the back of domestic pigs. A hard fat, pork fatback can be valorised whole, sliced, diced, or even ground, and it's used to add moisture, fat and flavor to a wide variety of meat products: it can also be seen as small spots of fat in salami or mortadella.

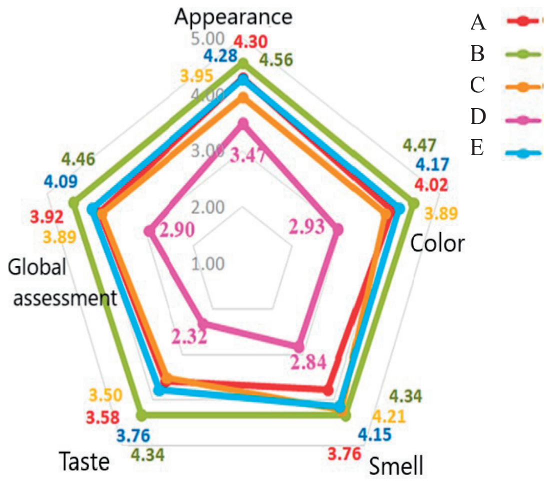

Figure 1. The results of sensory analysis

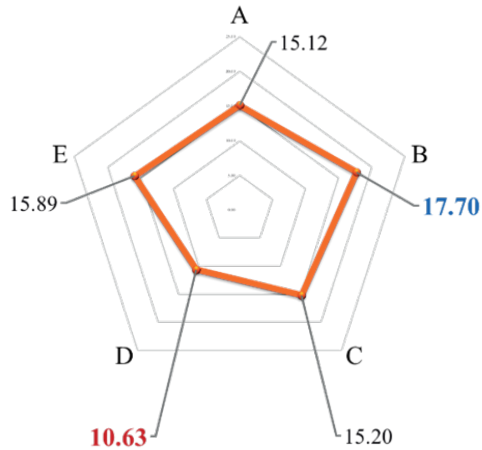

Figure 2. Weighted average score obtained after tasting

The nutritional information presented on the label by manufacturers, for 100 g of product are presented in Table 2.

Significant differences are observed at the level of protein and lipid content, respectively different energy value based on these variations for all five analyzed products.

Table 2. Nutritional information presented on the label, for 100 g of product

Nutritional information	Products				
	A	B	C	D	E
Energy value	1189 kJ/287 kcal	972 kJ/234 kcal	1031 kJ/249 kcal	1109 kJ/268 kcal	809 kJ/194 kcal
Lipids, % which saturated fatty acids	25	20	20.1	24.0	14.0
	9.1	7	7.8	8.8	3.8
Carbohydrates, % of which sugars	0.5	1.42	0.5	0	1.1
	0.2	0.36	0.5	0	0.7
Protein, %	15	13.66	16	13	16
Salt, %	1.6	2.01	1.7	2.3	2.1
Fiber, %	0	1.42	0	0	0

Following the determination of mineral substances (ash), the highest value was found for product C, 3.05%, in contrast to product A, which recorded a value of 2.08%.

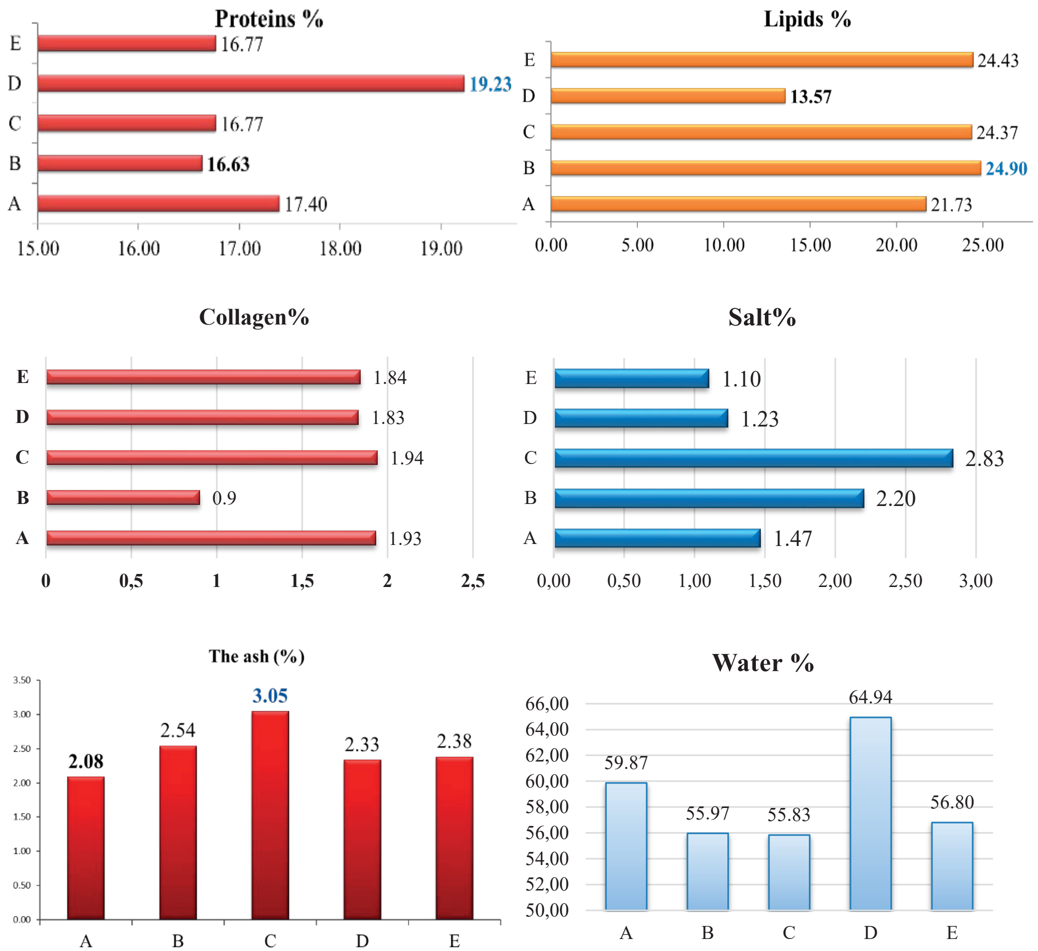

Figure 3. The results of chemical analysis of chicken hot dog sausages

According to the ingredients declared by the manufacturers, chicken breast is found in different percentages, the lowest amount being for product B (30% chicken breast), while product E has an amount of 70% chicken breast and 24% beef chickens from another anatomical region.
Although the B sausages have the least amount of meat, they were the most appreciated by the tasters following the sensory analysis. This fact may be due to the large amount of fat and salt, but also to the *monosodium glutamate* in its composition, which is a controversial flavor enhancer worldwide.
The E products, the ones with the largest amount of chicken meat, were less appreciated by the tasters, because of the poorly pronounced taste, but also the pungent, sour smell probably by the acids added in composition.
For all analyzed products, the amount of protein was supplemented with animal protein additions. The slightly higher amount of collagen for products A, B, C and D is probably due to the added chicken skin in their composition. The proportions of fatback, skin and water in the composition of sausages are not mentioned on the product label, because there are no regulations in this regard.
Comparing the results obtained with the admissibility conditions, according to standard SP 1472-85 (Figure 4), it appears that the five producers of chicken sausages respected the admissibility conditions imposed and fell within the maximum limit admitted. The exception is the C product, because the salt content had a slightly exceeded maximum limit (2.83% vs. 2.80%).

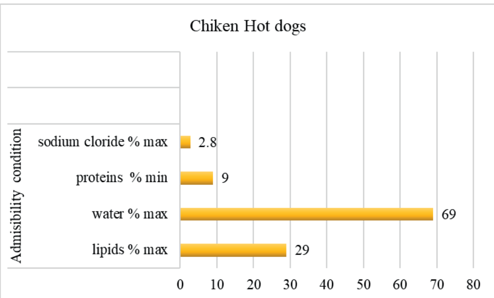

Figure 4. The admissibility conditions imposed for chicken hot dog sausages

The energy value for all studied chicken hot dog sausages (Figure 5) was close for products E, C and B, the smallest being recorded for D product. The lipids content is decisive for high or small energy value.

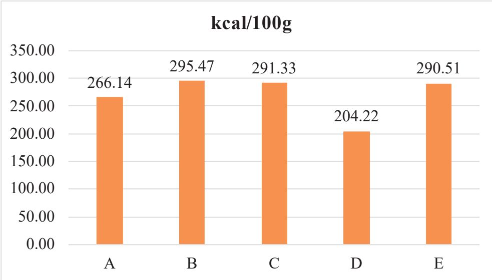

Figure 5. The energy value of studied chicken hot dog sausages

Food additives can be found in all the studied products, namely sausages A contain eleven additives, sausages B and D contain eight additives, sausages C contain seven additives, and sausages E contain four additives. Special attention should also be paid to the addition of carmine food coloring, which even if it is classified as natural pigments, can cause allergies, especially to people allergic to shellfish.
Following the study carried out, sausages are recommended to be consumed in moderation, from the point of view of the chemical composition, product E has superior properties compared to the rest of the analyzed products, but the low price and the quality class in which it was placed following the sensory analysis provide uncertainty.
Following the statistical evaluation of the differences of the means (Table 3) using the ***Tukey*** test, it was observed for product A vs. B: In lipids content: a significant difference ($p<0.05$), indicating that product A has a significantly lower lipid content than product B. This suggests a considerable difference in the fat profile between the two products.
Collagen: Significant difference ($p<0.05$), with lower values for product B, which may reflect a difference in protein structure and product quality. From the point of view of energy value, significant differences ($p<0.05$) were observed between products A and B, product A having a higher energy content. This can influence the nutritional value and energy quality of the

product. Salt, water, ash, dry matter, organic matter, NFS: No significant differences, suggesting that in these respects B and A are relatively similar D product stands out by significant differences from most other groups, having higher values for multiple characteristics. A and E showed significant differences in some measurements compared to other groups, while B and C are relatively similar to each other with limited significant differences. These results suggest that D and A are the most distinct in terms of nutritional profile and physical characteristics, and B and C are closer to each other.

A vs. C: Ash: Significant difference ($p<0.05$), indicating that C has a significantly higher ash content than A, which may reflect a difference in mineral content and manufacturing process.

Other measurements (lipids, proteins, collagen, salt, water, dry matter, organic matter, NFS, crude energy): No significant differences. This suggests that most of the chemical and nutritional characteristics are comparable between A and C.

A vs. E: Lipids, collagen, ash, NFS: Significant differences ($p<0.05$), with E having lower values in all these characteristics compared to A. This indicates a difference in the lipids content, protein quality and energy values of the products. Salt, water, dry matter, organic matter, gross energy: No significant differences, suggesting that these characteristics are relatively similar between the two groups.

A vs. D: Lipid, protein, collagen, salt, water, dry matter, organic matter, gross energy: All these characteristics show significant differences ($p<0.05$), with D having higher values compared to A. This suggests that D is significantly different in terms of nutrient and energy content, having a higher value in most aspects.

B vs. C: Collagen: Significant difference ($p<0.05$), C having higher collagen content compared to B, which may reflect a difference in protein quality. Other measurements (lipid, protein, salt, water, ash, dry matter, organic matter, NFS, crude energy): No significant differences, suggesting similarities between B and C in these aspects.

B vs. E: Salt, ash: Significant differences ($p<0.05$), having higher values in salt and ash compared to B. This could indicate differences in the mineral composition and salt content of the products. Other measurements (lipid, protein, collagen, water, dry matter, organic matter, gross energy): No significant differences, suggesting similarities in most other characteristics.

B vs. D: Lipids: Significant difference ($p<0.05$), D having a significantly higher lipid content compared to B. Other measurements (protein, collagen, salt, water, ash, dry matter, organic matter, gross energy): No significant differences, indicating that, apart from lipids, the other characteristics are similar between B and D.

C vs. E: Collagen, lipids: Significant differences ($p<0.05$), C having higher values for collagen and lipids compared to E. This suggests differences in protein and fat content between the two products. Other measurements (salt, water, ash, dry matter, organic matter, gross energy): No significant differences, suggesting similarities in these aspects.

C vs. D: Lipids, proteins, collagen, salt, water, dry matter: All these characteristics show significant differences ($p<0.05$), with D having higher values compared to C. This underlines significant differences in composition and nutritional value between the two products.

E vs. D: Lipid, protein, salt, water, dry matter, organic matter, NFS, crude energy: Significant differences ($p<0.05$), D having higher values in all these characteristics compared to E. This suggests that D is consistently richer in nutrients and energy than E.

The high acidity (Figure 6) in chicken sausages A may be due to the fact that ascorbic acid and lactic acid were used in their composition as an antioxidant and preservative.

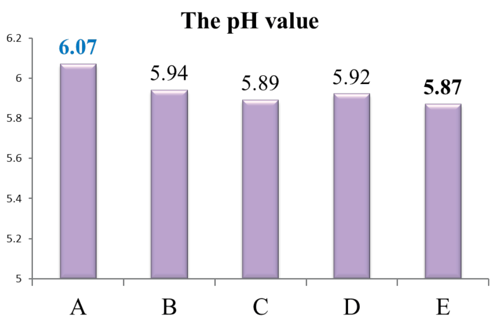

Figure 6. The average value of pH

Table 3. The statistical significance of differences regarding the chemical composition of some assortments of chicken hot dog sausages (Tukey test)

	Lipids		Proteins		Collagen		Salt		Water		Ash		Dry matter		Organic matter		NFS		Energy value	
	p value	Signif.	p value	Signif.	p value	Signif.	p value	Signif.	p value	Signif.	p value	Signif.	p value	Signif.	p value	Signif.	p value	Signif.	p value	Signif.
A - B	7.967	*	1.900	ns	1.930	*	0.833	ns	6.267	ns	0.574	ns	6.267	ns	6.841	ns	0.774	ns	66.742	ns
A - C	4.800	ns	1.133	ns	0.900	ns	0.100	ns	3.767	ns	1.030	*	3.767	ns	4.797	ns	1.130	ns	42.831	ns
A - D	5.333	*	1.267	ns	1.940	*	0.533	ns	4.233	ns	1.536	*	4.233	ns	5.769	ns	1.703	*	49.287	ns
A - E	16.133	*	3.733	*	1.830	*	1.067	*	12.800	*	0.822	ns	12.800	*	13.622	*	1.222	ns	134.309	*
B - C	3.167	ns	0.767	ns	1.030	*	0.733	ns	2.500	ns	0.456	ns	2.500	ns	2.044	ns	0.356	ns	23.911	ns
B - D	2.633	ns	0.633	ns	0.010	ns	1.367	*	2.033	ns	0.962	*	2.033	ns	0.928	ns	0.929	ns	17.455	ns
B - E	8.167	*	1.833	ns	0.100	ns	0.233	ns	6.533	ns	0.248	ns	6.533	ns	6.781	ns	0.448	ns	67.567	ns
C - D	0.533	ns	0.133	ns	1.040	*	0.633	ns	0.467	ns	0.506	ns	0.467	ns	2.972	ns	0.573	ns	41.366	ns
C - E	11.333	*	2.600	*	0.930	*	1.000	*	9.033	*	0.229	ns	9.033	*	4.737	ns	0.682	ns	43.656	ns
D - E	10.800	*	2.467	*	0.110	ns	1.633	*	8.567	*	0.734	ns	8.567	*	7.709	*	1.255	*	85.022	*

Statistically significance (Signif): * = significant differences; ns = insignificant differences.

Table 4. The declared ingredients and additives of some assortments of chicken hot dog sausages

Ingredients	A	B	C	D	E
Chicken breast	**50%**	**30%**	**55%**	**70%**	**40%**
Pork fatback	**?**	**?**	**?**	**-**	**?**
Chicken skin	**-**	**?**	**?**	**-**	**-**
Other ingredients	pork (30%), animal protein from pork, sugars	milk protein, modified potato starch, ***vegetable fibers***, sugars	milk protein, animal protein from pork, vegetable fibers, sugars	chicken (24%), milk protein (0.3%)	milk protein
Water	?	?	?	?	?
Salt	1.6	2.01	1.7	2.10	2,3
Spices	spice and flavoring extracts	natural spices	spice extracts, natural flavors	pepper, spice extracts, flavors	?
Additives	diphosphates, triphosphates, ascorbic acid, sodium ascorbate, sodium erythorbate, sodium lactate, E250 sodium nitrite, E262 sodium acetate, E270 lactic acid, E327 calcium lactate, smoke flavors	Na and K di-polyphosphates, E621 monosodium glutamate, ascorbic acid, E316 sodium isoascorbate, sodium nitrite, smoke flavors	diphosphates, sucrose, ascorbic acid, vegetable extract of red pepper, E120 carmine, sodium nitrite	sodium ascorbate, citrus fibers, sodium nitrite, smoke flavor	diphosphates, sodium acetate, sodium nitrite, E621 monosodium glutamate, ascorbic acid, sodium ascorbate, carmine, smoke flavors

The difference between the prices can be explained by the quality of the packaging, by the quality of the raw and auxiliary materials used, but also by the popularity of the brand at national level (Figure 7).

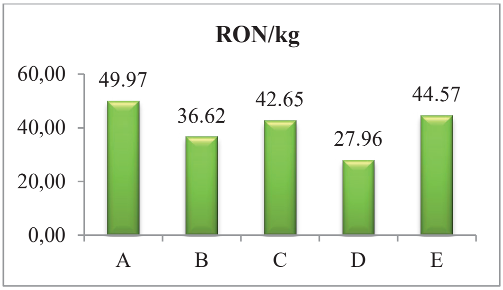

Figure 7. The average price of the products/kg from 2023

According to the most recent studies in the field of human nutrition, unfortunately the presentation of products with addressability, especially to children, is detrimental to their health if this type of product is consumed very frequently and in large quantities, without having a diversified diet (rich in fresh fruits and vegetables, whole grains, legumes and/or other sources of vegetable fiber).

The competent authorities should introduce updated regulations aimed at protecting the health of consumers in terms of saturated fat content and added additives, as it is well known the fact that the meat sausages /ultra-processed meat are declared potentially carcinogenic by the World Health Organization.

In recent years, however, there has been an improvement in the quality of the products available on the Romanian market, with the concept of a "*clean label*" appearing on the label of different food products, which also applies to the some assortments of chicken hot dog sausages.

CONCLUSIONS

The results of the sensory analysis revealed a minimum score for product D (10.63 points/ "unsatisfactory" product according to quality standards), compared to product B which obtained the best score among all the analyzed assortments (17.70 points/"product good"). Sausages from manufacturer B (with the least amount of meat) were the most appreciated by the evaluators following the sensory analysis, probably based on the high amount of fat and the addition of monosodium glutamate in its composition (an extreme controversial flavor enhancer worldwide). The results of the chemical analyses revealed high differences between producers at the level of fat content, 11.6 percentage points (13.5% vs. 25.1%), for the protein content the variability was less, 2.7 percentage points (16.6% vs. 19.3%), but also for the amount of water, 9.3 percentage points (57.2% vs. 66.5%). The salt content had a slightly exceeded maximum limit for product C (2.83% vs. 2.80% according to the standard), and the other products fell within the maximum allowed limit. For lipids, proteins and moisture, the products fell within the limits of the standard. The highest pH value was recorded for product A (pH = 6.07), probably due to the lactic and ascorbic acids in the composition. Of all the manufacturers analyzed, product D recorded the lowest energy value, due to the low fat content in the composition.

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