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Sensory analysis of value-added sausage formulations supplemented with tomato processing by-products

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Abstract

The main idea behind the research in this paper focused on the fact that to date there are few studies on the use of tomato processing by-products as an alternative source of biologically active compounds to replace synthetic additives in meat preparations. In this direction, the possibility of incorporating tomato processing by-products into sausage recipes as an alternative to synthetic additives, in particular sodium nitrite, is very attractive. This study aims to evaluate the effects of by-products resulting from the processing of large tomatoes and cherry tomatoes as natural antioxidants used to replace sodium nitrite in the recipe of smoked and dried sausages as well as smoked and scalded sausages. Tomato processing by-products, in powdered form, were used at four levels to provide a dose of total polyphenolic compounds equal to 50, 90, 180 and 270 mg gallic acid equivalents (GAE)/kg raw processed meat. Sensory analysis of products consists of evaluating the signals a person receives through the senses: sight, smell, hearing, taste and touch. The sense organs can be considered as detectors involved in transmitting information about the properties of food products from external stimulation to the brain. In the food industry, sensory evaluation is widely used to determine the sensory properties and quality of food. This assessment is extremely important because physico-chemical and microbiological analyses do not reveal the sensory value of food. The information obtained from this research could be useful for designing value-added nitrite-free sausage formulations by exploiting the bioactive potential of tomato processing by-products.

Keywords: large and cherry tomato, tomato processing by-products, smoked and dried sausages, smoked and scalded sausages, sensory analysis

1. Introduction

In recent decades, the concern of food researchers and technologists to identify natural ingredients and additives to replace artificial/synthetic ones is evident [1]. By-products from agri-food processing contain significant amounts of bioactive compounds that can be used to develop food products with added functional value [2, 3]. The fortification of meat products with functional ingredients rich in antioxidants allows increasing the content of bioactive compounds in the obtained products, which also leads to an increase in nutritional and sensory quality [4].

Tomatoes represent the second most cultivated vegetable in the whole world. Due to the high content of lycopene in tomatoes, a dye (red) and a natural antioxidant, it shows that they can be considered as a functional ingredient that can be used in meat products [5-7].

Tomatoes are a rich source of natural antioxidants such as lycopene, vitamin C, β-carotene and vitamin E [8, 9]. Doménech-Asensi et al. [10] reported that the addition of 10% tomato paste to the salami composition improved the product nutritionally (lycopene), color stability and decreased the degree of lipid oxidation during the two months of storage at 4°C. Thus, the MDA content in the control sample increased significantly during the 2-month storage period, from initial values of 42.05 to 59.17 mg MDA/100g, while the sample with the addition of tomato paste recorded values within the limit of 30- 40 mg MDA/100g. The results being encouraging, more investigations are needed for other varieties of meat products, with distributed attention also on different storage conditions.

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Sensory analysis refers to the assessment by trained and experienced analysts of a food product using sense organs (visual, olfactory, tactile, gustatory), followed by analysis of the recorded impressions [11, 12]. Until recently it was believed that the receptors are located on certain parts of the tongue: tip of the tongue-sweet taste; lateral edges of the front side-salty taste; root of the tongue-bitter taste, lateral edges of the back of the tongue-sour taste. However, studies have shown that receptors are evenly distributed over the entire surface of the tongue [13].

Rating tests are based on a system of scoring sensory perceptions with symbols. Numerical (hedonic) scales from 1 to 5 points or from 1 to 9 points, without 0 or 10, divided into 3 categories: lower, medium and upper, are used for sensory evaluation of food. The main conditions to be met for a correct sensory evaluation are: tasters must be in good health, not suffering from any sensory organ disorders that may influence sensory analysis; tasters must not consume alcoholic/non-alcoholic beverages prior to the evaluation; tasters must not have smoked for at least 2 hours prior to tasting; spicy food must be avoided for at least 12 hours before tasting; tasters may examine a maximum of 4 products at the same time [11].

In the present work we evaluate the sensory characteristics of some types of pork sausages (smoked and dried and smoked and scalded) supplemented with different amounts of tomato processing by-products in order to substitute the sodium nitrite in the manufacturing recipe.

2. Materials and Methods

2.1. Sample preparation

Twenty-one samples of sausages were prepared according to the basic recipe: pork 800 g, pork fat 200 g, salt 18 g, sweet pepper 6 g, garlic 16 g, white pepper 2 g and black pepper 2 g. In the positive control samples, salt was replaced by a salt mixture containing 0.5% sodium nitrite. Two types of sausages were prepared, such as smoked and dried, as well as smoked and scalded [2]. The raw large and cherry tomato processing by-products were subjected to convective drying at 60°C for 16 hours and the dried by-products (SRMU, SRCU), in powdered form, were used to substitute the sodium nitrite in the sausage formulas at four levels, in order to ensure a dose of total polyphenolic compounds equal to 50, 90, 180 and 270 mg gallic acid equivalents (GAE)/kg raw processed meat. Thus, the resulting sausage formulations were scored as follows: control sample without addition and not heat treated (CM); sample without addition and treated by smoking and drying (CMU); sample without addition and treated by smoking and scalding (CMF); sample with sodium nitrite treated by smoking and drying (CMUN); sample with sodium nitrite and treated by smoking and scalding (CMFN); 4 samples of smoked and dried sausages with different amounts of large tomato processing by-product (CUSRMU50, CUSRMU90, CUSRMU180, CUSRMU270); 4 samples of smoked and scalded sausage formulations with different amounts of large tomato processing by-product (CFSRM50, CFSRM90, CFSRM180, CFSRM270); 4 samples of smoked and dried sausages with different amounts of cherry tomato processing by-product (CUSRCU50, CUSRCU90, CUSRCU180, CUSRCU270); 4 samples of smoked and scalded sausage formulations with different amounts of cherry tomato processing by-product (CFSRC50, CFSRC90, CFSRC180, CFSRC270). All sausage formulations were stored under refrigerated conditions for 20 days.

2.2. Sensory analysis

The sensory evaluation shall be carried out in a clean, daylight room, free of foreign odours. The 21 sausage samples were evaluated by a group of 27 evaluators (16 women and 11 men), non-smokers, aged between 21 and 53, with no known cases of food allergies. Samples were presented once to each panellist in plastic plates marked with two-digit characters. Panelists rated the sensory attributes of the coded sample, including appearance, color, texture, smell (aroma), taste, and overall acceptability according to their rating, and awarded points according to the five-point hedonic scale) as follows: 5 - extremely liked; 4 - moderately liked; 3 - neither liked nor disliked; 2 - slightly disliked; 1- extremely disliked [14].

The score intervals and acceptability level are grouped as follows: 1.00-1.49 (extremely disliked); 1.5-2.49 (slightly disliked); 2.50-3.49 (neither liked nor disliked); 3.5-4.49 (slightly liked); 4.5-5.00 (extremely liked). Raters were asked to rinse their mouths with plain water between ratings [11, 14].

The sensory properties of the 21 experimental sausage variants were assessed by 27 people (16 women and 11 men) aged 21 to 53 years, who were instructed to rate the specific characteristics of the

products and to give scores on a scale of 1 to 5 (5-point hedonic test). The 5-point scoring system was used for the following characteristics: colour, smell (aroma), texture, taste and overall acceptability.

3. Results and Discussions

Sensory evaluation of the samples was carried out to identify the acceptability of the products obtained. Figures 1-8 show the average values obtained from the evaluation of the attributes (colour, smell, taste, texture and general acceptability) of the meat products studied.

The best rated sample was CUSRMU270 (smoked and dried sausage with 24.821 mg SRMU/kg raw processed meat) scoring 4.889 for the taste criteria and 4.993 for colour and overall acceptability (Figure 1), falling within the 4.50-5.00 score range, indicating high acceptability (HA) compared to the control sample.

In terms of taste, the mean scores given by the evaluators increased in the order: CM > CMF > CMUN > CMU > CMFN > CUSRMU50 > CUSRMU90 > CUSRMU180 > CUSRMU270, suggesting that the addition of 24.821 mg SARU/kg raw processed meat was the most appreciated sample by the evaluators (Figure 1 and 2).

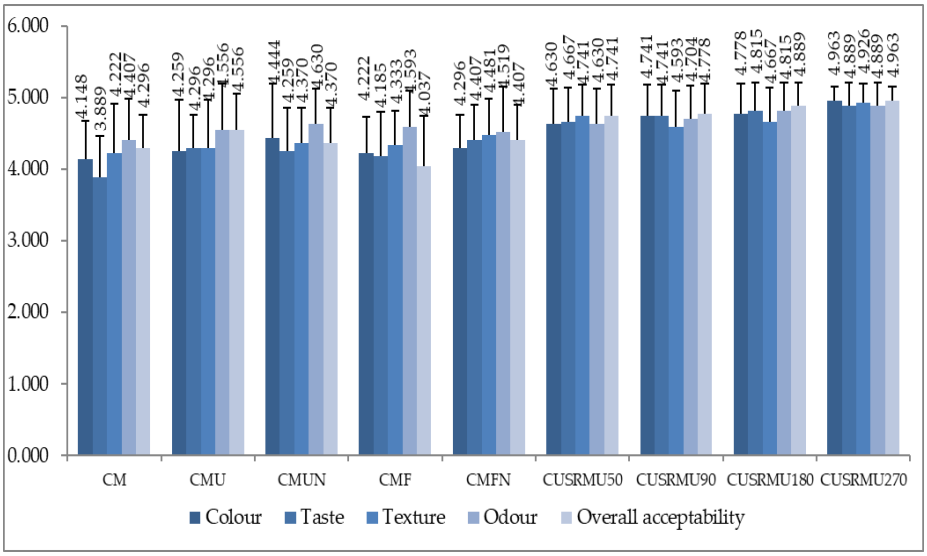

Figure 1. Average values of the sensory evaluation of smoked and dried sausage samples (CUSRMU) with addition of large tomato processing by-product obtained using the 5 - point hedonic scale (n=27)

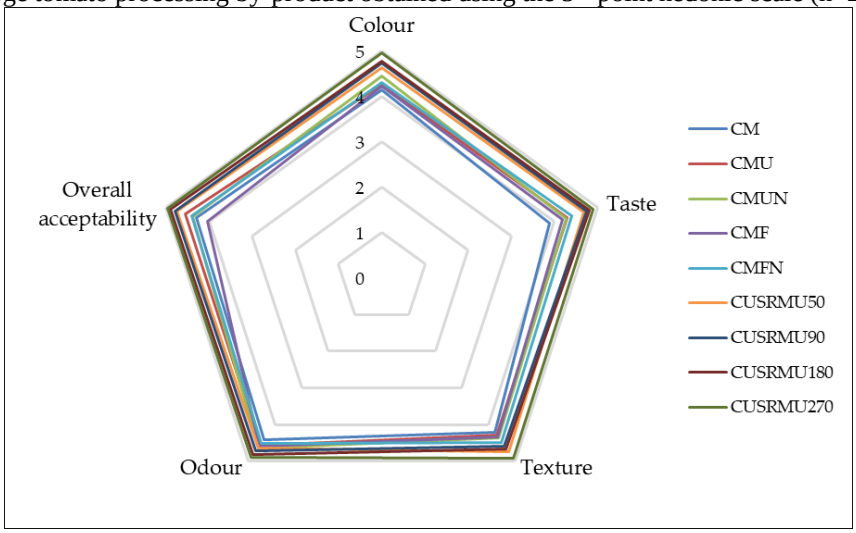

Figure 2. Sensory evaluation score of smoked and dried sausage samples with addition of large tomato processing by-product (CUSRMU) (n=27)

The addition of tomato by-products did not influence the texture of the products, with the scores given by the evaluators for these criteria increasing in order: CM > CMU > CMF > CMUN > CMFN > CUSRMU50 > CUSRMU90 > CUSRMU180 > CUSRMU270. For the criteria General Acceptability the scores awarded increased in the following order: CMF > CM > CMUN > CMFN > CMU > CUSRMU50 > CUSRMU90 > CUSRMU180 > CUSRMU270.

The smoked and scalded sausage (CFSRMU) samples were highly rated by the evaluators, with the highest scores for CFSRMU270 (with 24.821 mg SRMU/kg raw processed meat), 4.815 points for colour, 4.778 for taste, 4.704 for texture, 4.741 for flavour and 4.778 points for the overall acceptability criterion (Figure 3 and 4).

In terms of taste, the scores of the analysed samples increased in the following order: CM > CMF > CMUN > CMU > CFSRMU50 > CMFN > > CFSRMU90 > CFSRMU180 > > CFSRMU270, and in terms of overall acceptability the highest points were obtained by the CFSRMU270 samples (4.778 points), CFSRMU180 (4.667 points), CFSRMU90 (4.593 points), CMU (4.556 points), followed by CFSRMU50 (4.519 points), CMFN (4.407 points), CMUN (4.370 points), CM (4.296 points) and CMF (4.037 points) (Figure 3 and 4).

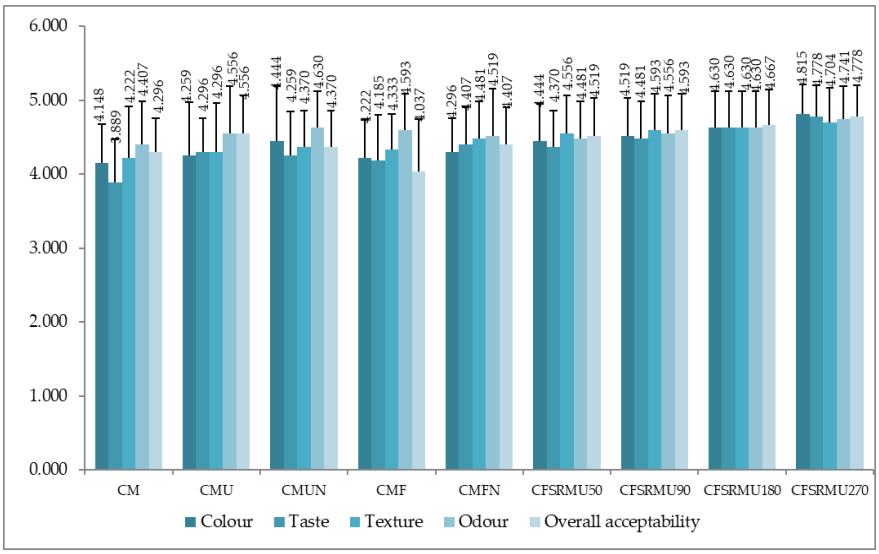

Figure 3. Mean values of the sensory evaluation of the smoked and scalded sausage samples (CFSRMU) with addition of large tomato processing by-products, obtained using the 5-point hedonic scale (n=27)

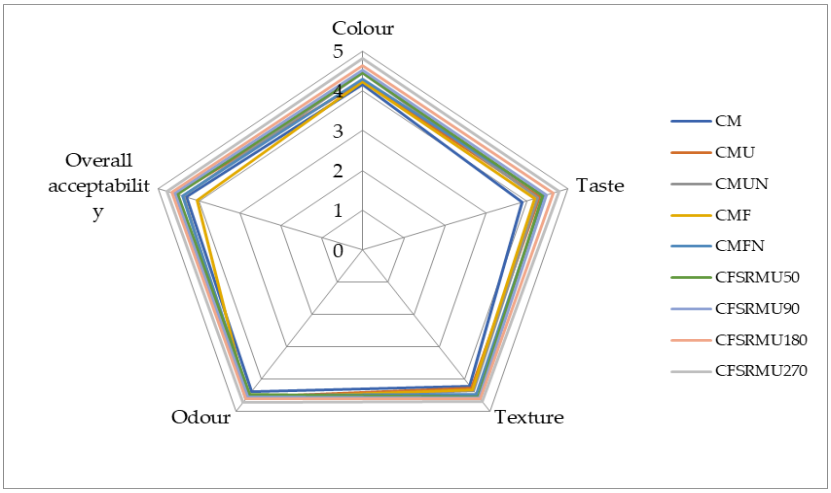

Figure 4. The scores obtained following the sensory evaluation of smoked and scalded sausage samples with addition of large tomato processing by-product (CFSRMU) (n=27)

As regards the sausage formulas with addition of cherry tomato by-product, the results obtained by sensory analyses were shown in Figures 5-8. Following centralization of the scores awarded by the 27 assessors, the following results were recorded: the samples of smoked and dried sausages with 5.811 mg SRCU/kg raw processed meat, 10.460 mg SRCU/kg raw processed meat, 20.920 mg SRCU/kg raw processed meat and 31.380 mg SRCU/kg processed raw meat, the most highly rated was sample CUSRCU270 (31.380 mg SRCU) with scores ranging from 4.741 (texture) to 4.852 (colour and general acceptability) (Figure 5 and 6).

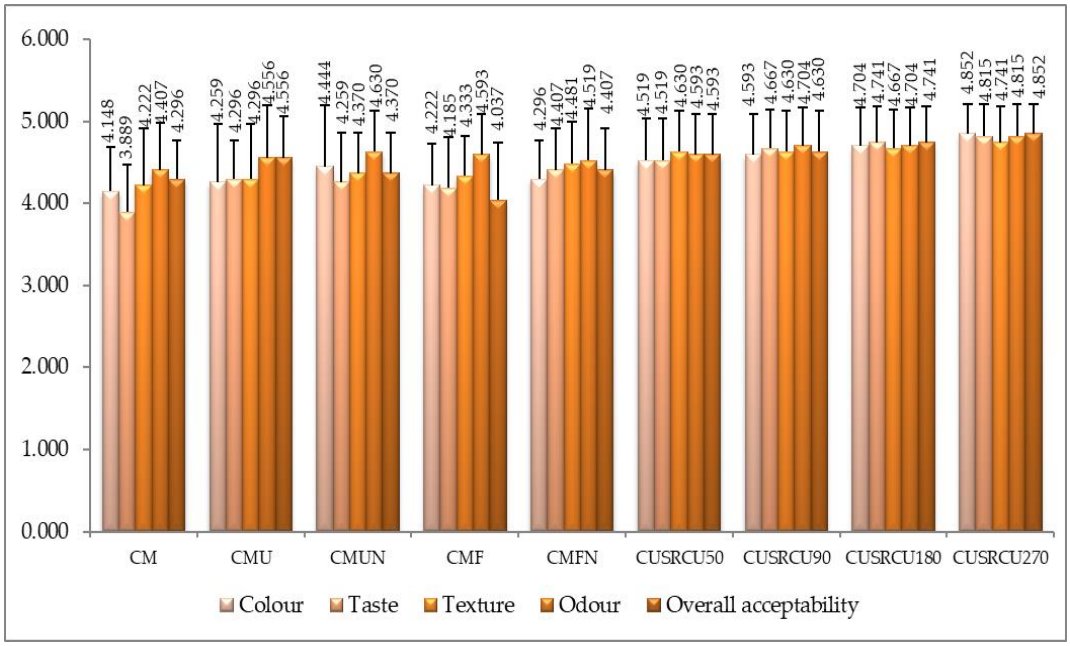

Figure 5. Average sensory evaluation values of smoked and dried sausage samples (CUSRCU) supplemented with cherry tomato processing by-product, obtained using the 5-point hedonic scale (n=27)

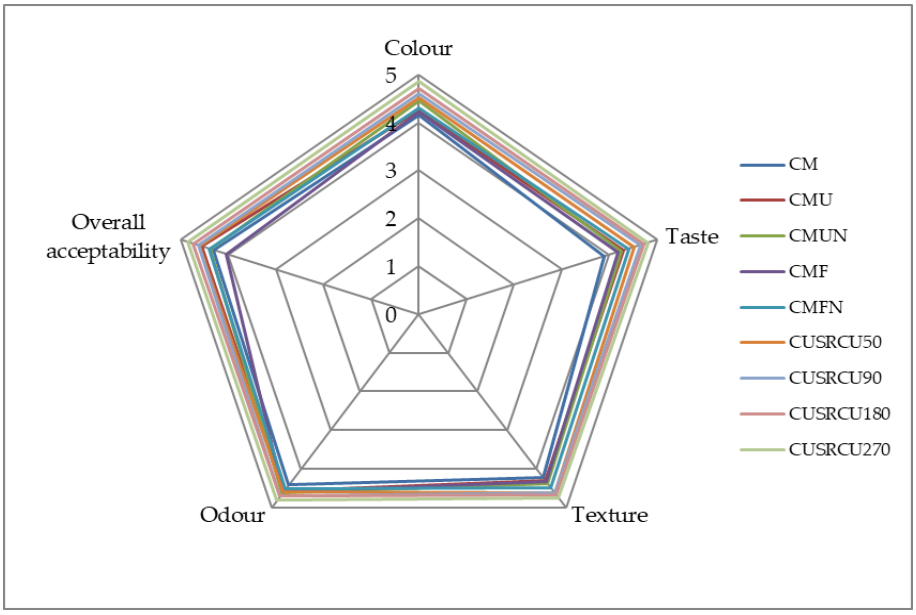

Figure 6. Scores obtained from the sensory evaluation of smoked and dried sausage samples supplemented with cherry tomato processing by-product (CUSRCU) (n=27)

The sensory evaluation scores of smoked and dried sausage samples with different proportions of by-products from tomato processing (CUSRCU) increased in the following order: CMF > CM > CMUN > CMFN > CMU > CUSAGU50 > CUSAGU90 > CUSAGU180 > CUSAGU270 (Figures 7 and 8).

The best rated sample was CFSRCU270 (smoked and cooked sausage with 31,380 mg SRCU/kg raw processed meat) scoring 4.704 for texture criteria and 4.889 for overall acceptability (Figure 3.9 and 3.10), falling within the score range 4.50-5.00, indicating high acceptability (HA) compared to the control sample.

In terms of taste, the average scores given by the evaluators increased in the order: CM > CMF > CMUN > CMU > CMFN > CFSAGU50 > CFSAGU90 > CFSAGU180 > CFSAGU270, and in terms of overall acceptability the sample scores increased as follows: CMF > CM > CMUN > CMFN > CMU > CFSAGU50 > CFSAGU90 > CFSAGU180 > CFSAGU270 (Figure 3.7 and 3.8).

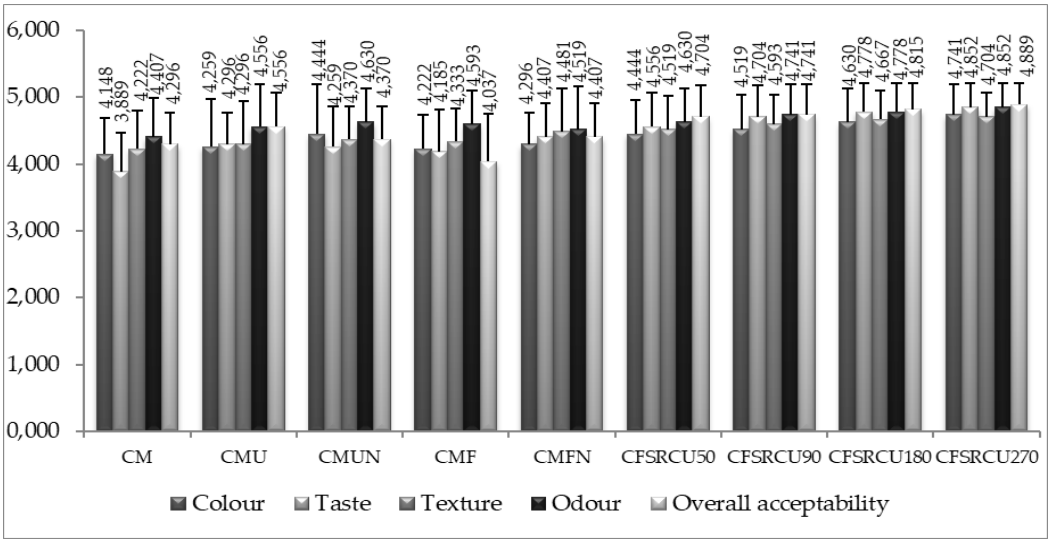

Figure 7. Mean values of the sensory evaluation of smoked and scalded sausage samples (CFSRCU) supplemented with cherry tomato processing by-product, obtained using the 5-point hedonic scale (n=27)

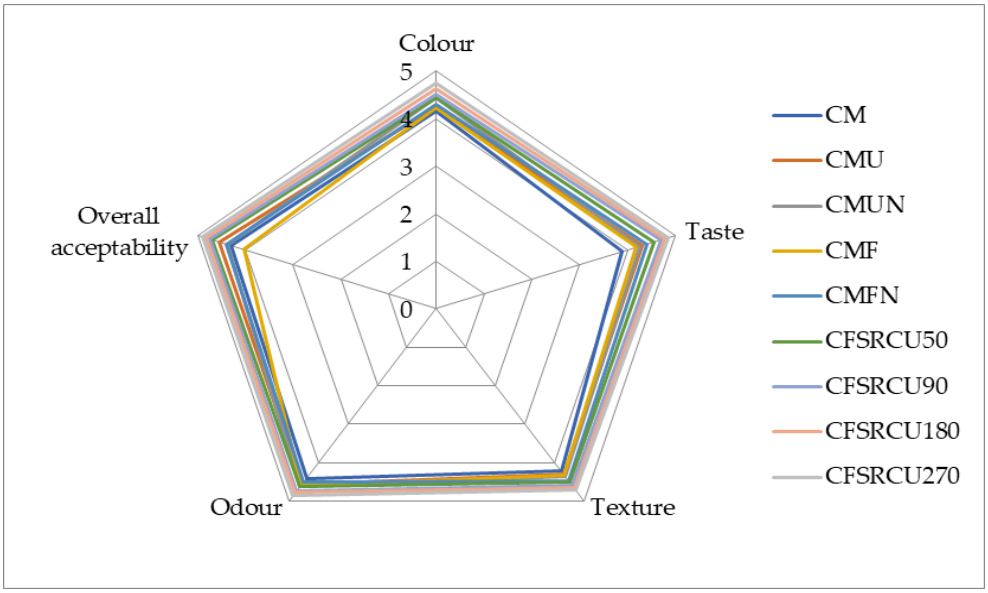

Figure 8. Scores obtained from the sensory evaluation of smoked and scalded sausage samples supplemented with cherry tomato processing by-product (CFSRCU) (n=27)

4. Conclusion

Sensory analysis of the sausage formulas led to the finding that the samples supplemented with the highest amounts of tomatoes processing by-products obtained the highest scores for all attributes assessed: CUSRMU270 (smoked and dried sausages with 24.821 mg SRMU/kg raw processed meat), CFSRMU270 (smoked and cooked sausages with 24.821 mg SARU/kg raw processed meat), CUSRMU270 (smoked and dried sausages with 31.380 mg SRMU/kg raw processed meat) and CFSRMU270 (smoked and cooked sausages with 31.380 mg SRMU/kg raw processed meat). These samples scored between 4.5 and 5 indicating high acceptability (HA) compared to the control sample for all attributes assessed: colour, taste, smell (flavour), texture and overall acceptability. The results demonstrate that the tomato processing by-products can be used as natural antioxidants to develop nitrite-free pork sausages in line with consumer requirements.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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