JMBFS
Journal of Microbiology, Biotechnology and Food Sciences
International peer-reviewed scientific online journal

Published by Faculty of Biotechnology and Food Sciences

EFFECT OF TOMATO POMACE ON SENSORY AND TEXTURAL PROPERTIES OF RAW-COOKED MEAT PRODUCT

Andrea Mesárošová, Marek Bobko, Lukáš Jurčaga, Alica Bobková, Katarína Poláková, Alžbeta Demianová, Miroslav Kročko, Tomáš Tóth, Judita Lidiková*

Address(es): doc. Ing. Marek Bobko, PhD.
Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Institute of Food Science, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia.

*Corresponding author: marek.bobko@uniag.sk

https://doi.org/10.55251/jmbfs.11016

ARTICLE INFO

Received 9. 2. 2024
Revised 9. 7. 2024
Accepted 15. 7. 2024
Published 1. 10. 2024

Regular article

OPEN ACCESS

ABSTRACT

In the meat industry, there is a growing interest in the use of innovative processing methods, reformulated products, and the replacement of synthetic ingredients with natural bioactive compounds. Replacing synthetic antioxidants with natural antioxidants is a challenging process, but it can bring positive results. Our current research focuses on sensory and textural properties of raw-cooked meat product (frankfurters), which we observed on the 1st, 7th, 14th and 21st days of storage. We incorporated extract from tomato pomace into frankfurters as natural antioxidants. We used two concentrations of extract (3 mL.kg^{-1} and 5 mL.kg^{-1}), the control with the addition of ascorbic acid and negative control. Sensory quality of meat product is one of the most important indicators that can influence the consumer. In the taste parameter, the best rated groups were Con-C and TCP-2. Furthermore, the addition of tomato pomace extract does not cause a significant change in the consistency of the meat products. After textural analysis, no statistically significant differences were observed between individual samples in any of the evaluated parameters.

Keywords: natural antioxidant, tomato, pomace, sensory, textural analysis

INTRODUCTION

Meat consuming is now thought to have a number of both direct and indirect negative effects on human health, the environment, and animal welfare in addition to being a source of beneficial substances **(Moreira *et al.*, 2022)**. Researchers are looking for innovative methods of processing based on reducing the addition of additives (such as salt and nitrite/nitrate), the development of potentially harmful substances during processing (like N-nitrosamines, biogenic amines, and polycyclic aromatic hydrocarbons), and the addition of raw materials rich in bioactive components (like probiotics, antioxidants, and dietary fibers) in order to improve the nutritional value of meat products **(Karwowska *et al.*, 2021).** Meat products deteriorate in quality mostly due to oxidation of proteins and lipids, and growth of microorganisms. Meat products can lose their aroma and taste due to a variety of breakdown products that are formed as a result of lipid oxidation. Moreover, proteins are very vulnerable to oxidative changes. These changes contribute to a change in meat color as well as its succulence and softness **(Lund *et al.*, 2010).**

One of the interesting and valuable plant material is the tomato and tomato co-products. Tomatoes and their co-products are very popular because of their rich composition. They contain a high amount of lycopene, phenols, vitamins, organic acid and other beneficial compounds **(Skwarek & Karwowska, 2023).**

The tomato processing industry produces a significant amount of pomace. Most of the waste produced during tomato processing is in the form of pomace (containing seed and peel). If this material is not used, they not only contribute to environmental contamination but also contribute to disposal issues. Compounds with high biological activity can be found in seeds and peels **(García *et al.*, 2009)**. The tomato peel contains large amounts of lycopene, up to five times more than the pulp. Tomato pomace also has other beneficial components including lipids, proteins, and minerals **(Hernández-Fuentes *et al.*, 2017).** Natural food components are becoming more and more important because of their increased usage in food, cosmetics, and medicines as a result of EU directives that favor natural over synthetic chemicals **(García *et al.*, 2009).** Tomato peels also contain acid detergent fiber. Because tomato peel is a co-product of processing tomatoes and contains both fiber and lycopene, adding it to meat products can make them healthier **(Knoblich *et al.*, 2005)**. Lycopene is one of the strongest carotenoids, has the best potential for antioxidants and can be employed as an intense red colorant and to prevent food oxidation in functional foods, medicines, and cosmetics **(Da Silva *et al.*, 2023).**

Antioxidants have been added to meat products in a number of studies to either preserve their original properties during storage or enhance their health benefits. But the addition of tomatoes or lycopene to meat products hasn't been the subject of many research papers.

The aim of this study was to incorporated natural extract from tomato pomace into raw-cooked meat product. We monitored the effect of the extract on the textural properties of the product during 21 days of storage at refrigerator temperature and performed a sensory evaluation.

MATERIAL AND METHODS

Extract Preparation

The plant material - tomato pomace was provided by Botanic Garden of SUA in Nitra. Tomato co-product extract was prepared according to **Shirahigue *et al.* (2010)**. The finished extract was stored under refrigerated conditions at 4°C.

Meat Product Preparation

The meat product was made using the following ingredients: water, pork meat, nutmeg, black pepper, sweet and sour paprika, and a salting mixture containing 0.3% sodium nitrite. After all of the ingredients were combined, the extract was added. The finished pork meat products were vacuum-sealed, packaged, and stored at 4°C for 21 days after being heat-cured by wet smoking to reach a core temperature of 70°C for at least 10 minutes.

We prepared 4 experimental groups. No antioxidant ingredient was used in the preparation of the control group (Con). Ascorbic acid (0.5 g.kg^{-1}) was present in the second control group (Con-C). The extract from tomato pomace was 3 mL.kg^{-1} in the third group (TCP1) and 5 mL.kg^{-1} in the fourth group (TCP2). In each group, 3 samples were analyzed, and 3 repetitions were performed for each measurement.

Textural Analysis

The textural properties were determined using the TA.XTplus Texture Analyzer (Godalming, UK) as the texture analyzer device. The meat products were cooked before analysis. Before the analysis, the products were cut into 1x1 cm blocks. Using the default settings for the hot-dog analysis, we selected a Warner-Bratzler probe (V-blade). The toughness and firmness measurements were observed. On the 1st, 7th, 14th and 21st days, the texture analysis was measured.

Sensory Evaluation

The panel of experts performed the sensory evaluation on the 7th, 14th and 21st days. Every sample was heated before to the evaluation and were arranged in randomized order. A test with a hedonic scale was used for sensory evaluation. Each parameter was assigned a number between 1 and 5. The number 5 represents the highest score and the number 1 the lowest score. We calculated the average value from each parameter and sample. There was an evaluation of five sensory parameters: overall appearance, odor, consistency, color and taste. The sensory panel was made up of 6 trained evaluators, both male and female, ranging in age from 25 to 50. The Institute of Food Sciences provided all the evaluators. The evaluators had experience in rating meat products.

Statistical Analysis

The analysis was conducted using the statistical and data analysis package XLSTAT (Addinsoft, 2021, New York, USA). Results of the various analysis groups were compared using an ANOVA analysis and a Duncan test. For every test, the significance threshold was set at 0.05.

RESULTS AND DISCUSSION

Textural Analysis

The aim of this analysis was to determine whether the addition of tomato co-product extract will affect the firmness and toughness of the meat product. Firmness has no standard scientific definition. It is a descriptive term. However, in textural analysis it is accepted as being either the force at the maximum distance of a compression cycle or, as in our case, as the maximum force reached prior to a fracture. Toughness is described as a force in time, which is needed to cut through the whole piece of a sample. After the first day of storage, no statistically significant differences were observed between individual samples in the firmness parameter.

Figure 1 Result of textural analysis
Legend: Con= negative control, Con-C= control with 0.5 g.kg^{-1} ascorbic acid, TCP1= 3ml.kg^{-1} tomato pomace extract, TCP2= 5ml.kg^{-1} tomato pomace extract.

On the contrary, statistically significant differences were found in the toughness parameter. The control group with the addition of ascorbic acid (Con-C) and the experimental group (TCP2) were significantly different from the control group without the addition of antioxidant (Con) and the experimental group (TCP1). Subsequently, during the entire storage period, no statistically significant differences were observed between individual samples or between the evaluated parameters. Results are shown in the figure 1. **Jurčaga *et al.* (2021)** added blackcurrant and kamchatka honeysuckle extracts to raw-cooked meat product. They did not observe any significant differences among all groups ($\alpha = 0.05$). Their measurement shows that natural antioxidant has no effect on textural properties of raw-cooked meat product (Frankfurters). **Savadkoohi *et al.* (2014)** observed the effect of different concentrations of tomato pomace in beef frankfurters. Their textural results showed that there were no significant differences between the adhesion, elasticity of the prepared preparations and the control samples, while the hardness and cohesion were affected by the level of tomato pomace.

Sensory Evaluation

The most important factor affecting customer satisfaction is the product's sensory quality. No experimental addition can change quality indicators like taste or odor. Our objective was to observe changes in the chosen parameters over the course of the storage period. The sausages were stored for 3 weeks, during which a sensory evaluation took place every week. We noted very little variances between the individual parameters in the experimental groups, as you can see in figure 2. We noticed the greatest variance in the color and odor of the samples. As for the most important parameter from the consumer's point of view - taste, the best rated group was Con-C and experimental group TCP2.

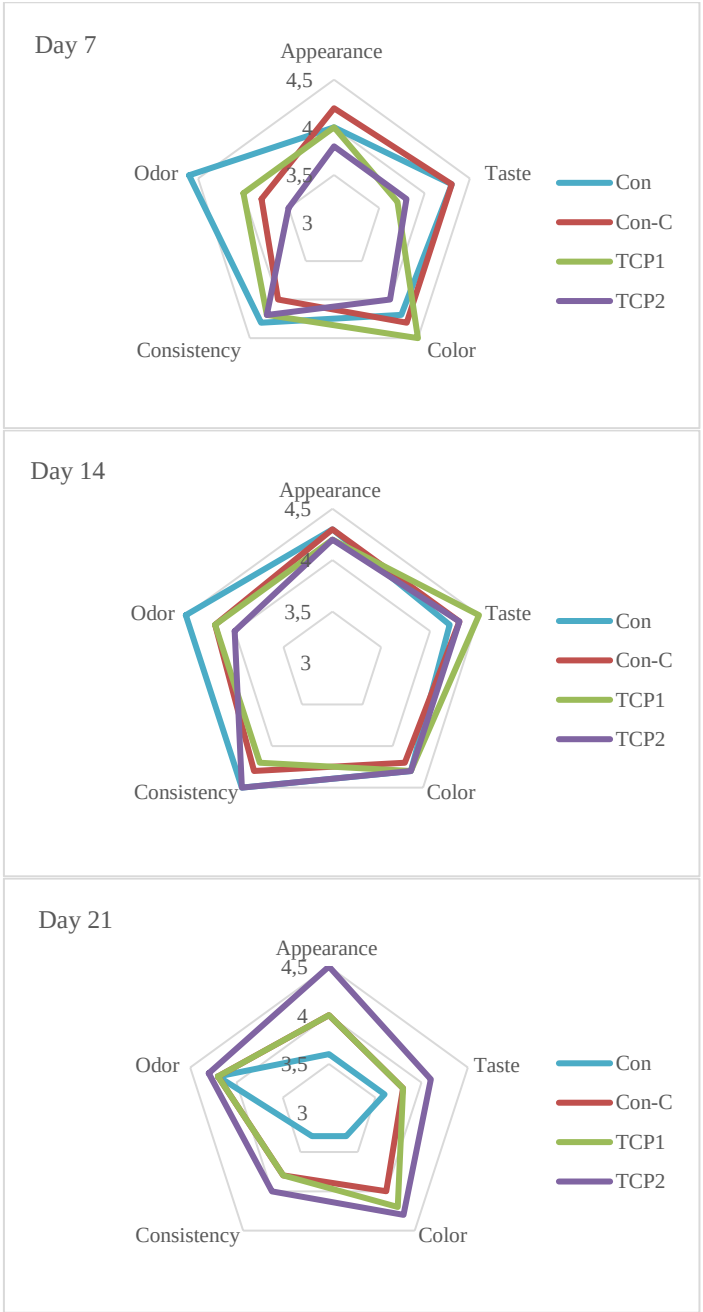

Figure 2 Results of sensory evaluation from 7th, 14th and 21st days

The average consistency score ranged from 4.0 to 4.2 points. With these obtained results and the texture analysis performed, we can conclude that the addition of tomato co-product extract does not cause a significant change in the consistency of the meat products. In our case, we observed a slight improvement compared to the control group and the control group (Con) with the addition of ascorbic acid (Con-C). Total scores of all groups were comparable and without significant difference ($\alpha = 0.05$). **Ghafouri *et al.* (2020)** observed the effect of tomato powder (3%) in boiled and fried sausages. After the addition of the powder, the evaluators did not observe a negative effect either in boiled or fried sausages. In comparison with our results, neither the authors of **Calvo *et al.* (2008)** did not observe significant differences between samples for all parameters. Although in their case color significantly influenced preference, all samples showed good overall acceptability and in all cases the values were higher than 6 points. **Savadkoohi *et al.* (2014)** added tomato pulp powder in 4 concentrations (1, 3, 5 and 7%) to beef sausages. Color intensity scores for beef sausages containing 7% (w/w) tomato paste were significantly ($p < 0.05$) lower than the control. In addition, they observed no significant differences in aroma, taste, texture and juiciness values between other beef sausages and were mostly comparable to the control or sometimes even better.

CONCLUSION

In our study, we incorporated tomato pomace extract (3 $mL.kg^{-1}$ and 5 $mL.kg^{-1}$) into raw-cooked meat product (Frankfurters). We monitored the effect of the added extract on the texture and sensory quality of the meat product for 21 days. During the entire storage period, no statistically significant differences were observed between individual samples or between the evaluated parameters in textural analysis. During the sensory analysis, we noticed the greatest variance in the parameters of color and aroma of the samples. The best evaluated samples in terms of taste were the Con-C group and the experimental group with 5 $mL.kg^{-1}$ of extract (TCP-2). We can conclude that the addition of tomato co-product extract does not cause a significant change in the consistency of the meat products. We recommend further study of this extract in different foods. Tomato co-products appear to be a suitable substitute for synthetic antioxidants in meat products. However, further research is still needed.

Acknowledgments: This work was supported by the Slovak Research and Development Agency under grant KEGA 001 SPU — 4/2023, VEGA 1/0402/23 and project Visegrad+ Grant 22230075 — Food Quality in Digital Age.

REFERENCES

Calvo, M. S. R., García, M. L., & Selgas, M. (2008). Dry fermented sausages enriched with lycopene from tomato peel. *Meat Science*, *80*(2), 167–172. https://doi.org/10.1016/j.meatsci.2007.11.016

Da Silva, P. B. V., De Paiva, L. B. B., & Mariutti, L. R. B. (2023). Waste and by-products as sources of lycopene, phytoene, and phytofluene - Integrative review with bibliometric analysis. *Food Research International*, *169*, 112838. https://doi.org/10.1016/j.foodres.2023.112838

García, M. L., Calvo, M. S. R., & Selgas, M. (2009). Beef hamburgers enriched in lycopene using dry tomato peel as an ingredient. *Meat Science*, *83*(1), 45–49. https://doi.org/10.1016/j.meatsci.2009.03.009

Ghafouri-Oskuei, H., Javadi, A., Asl, M. R. S., Azadmard-Damirchi, S., & Armin, M. A. (2020). Quality properties of sausage incorporated with flaxseed and tomato powders. *Meat Science*, *161*, 107957. https://doi.org/10.1016/j.meatsci.2019.107957

Hernández-Fuentes, A. D., López-Vargas, E. R., Pinedo-Espinoza, J. M., Campos-Montiel, R. G., Valdés-Reyna, J., & Juárez-Maldonado, A. (2017). Postharvest Behavior of Bioactive Compounds in Tomato Fruits Treated with Cu Nanoparticles and NaCl Stress. *Applied Sciences*, *7*(10), 980. https://doi.org/10.3390/app7100980

Jurčaga, L., Bobko, M., Kolesárová, A., Bobková, A., Demianová, A., Haščík, P., Belej, Ľ., Mendelová, A., Bučko, O., Kročko, M., & Čech, M. (2021). Blackcurrant (Ribes nigrum L.) and Kamchatka Honeysuckle (Lonicera caerulea var. Kamtschatica) Extract Effects on Technological Properties, Sensory Quality, and Lipid Oxidation of Raw-Cooked Meat Product (Frankfurters). *Foods*, *10*(12), 2957. https://doi.org/10.3390/foods10122957

Karwowska, M., Stadnik, J., Stasiak, D. M., Wójciak, K. M., & Lorenzo, J. M. (2021). Strategies to improve the nutritional value of meat products: incorporation of bioactive compounds, reduction or elimination of harmful components and alternative technologies. *International Journal of Food Science & Technology*, *56*(12), 6142–6156. https://doi.org/10.1111/ijfs.15060

Knoblich, M., Anderson, B., & Latshaw, D. (2005). Analyses of tomato peel and seed byproducts and their use as a source of carotenoids. *Journal of the Science of Food and Agriculture*, *85*(7), 1166–1170. https://doi.org/10.1002/jsfa.2091

Lund, M. N., Heinonen, M., Baron, C. P., & Estévez, M. (2010). Protein oxidation in muscle foods: A review. *Molecular Nutrition & Food Research*, *55*(1), 83–95. https://doi.org/10.1002/mnfr.201000453

Moreira, M. N. B., Da Veiga, C. P., Da Veiga, C. R. P., Reis, G. G., & Pascuci, L. (2022). Reducing meat consumption: Insights from a bibliometric analysis and future scopes. *Future Foods*, *5*, 100120. https://doi.org/10.1016/j.fufo.2022.100120

Savadkoohi, S., Hoogenkamp, H., Shamsi, K., & Farahnaky, A. (2014). Color, sensory and textural attributes of beef frankfurter, beef ham and meat-free sausage containing tomato pomace. *Meat Science*, *97*(4), 410–418. https://doi.org/10.1016/j.meatsci.2014.03.017

Shirahigue, L. D., Plata-Oviedo, M., De Alencar, S. M., D'Arce, M. A. B. R., De Souza Vieira, T. M. F., Oldoni, T. L. C., & Contreras-Castillo, C. J. (2010). Wine industry residue as antioxidant in cooked chicken meat. International Journal of Food Science & Technology, 45(5), 863–870. doi: https://doi.org/10.1111/j.1365-2621.2010.02201.x

Skwarek, P., & Karwowska, M. (2023). Fruit and vegetable processing by-products as functional meat product ingredients -a chance to improve the nutritional value. *LWT*, *189*, 115442. https://doi.org/10.1016/j.lwt.2023.115442