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Original scientific paper

Effect of chokeberry (*Aronia melanocarpa)* extract on the sensory properties of raw cooked meat products (frankfurters)

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ABSTRACT

The current research focuses on sensory and textural properties and color changes of soft meat products (frankfurters), which we observed on days 1 and 21 of storage. We incorporated chokeberry extract into frankfurters as natural antioxidants. We used two concentrations of extracts (3 mL kg^{-1} and 5 mL kg^{-1}), the control with the addition of vitamin C and negative control. A colorimeter and instrumental texture analyser were used to create the texture and color profiles. At the beginning of storage, the group with added vitamin C had the lightest L* parameter, and there were no statistically significant differences between the a* and b* parameters. After 21 days, the values of all color parameters decreased. When determining textural properties, no negative effect was observed after the addition of extracts. According to sensory evaluations, the groups supplemented with natural antioxidants, and the control supplemented with vitamin C improved consumer acceptability and preference.

1. Introduction

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. Innovative methods could minimize health problems and improve the overall organoleptic, nutritional and health properties of processed meat (*Jiang & Xiong*, 2016). These strategies are in line with customer expectations, who increasingly prefer the addition of natural antioxidants and colorants derived from plants over synthetic varieties (*Kowalczyk et al.*, 2023). The main components of plant materials in this context are phenolic acids, which contribute to their antioxidant capacity (*Munekata et al.*, 2016; *Şahin et al*., 2017). The concentration of antioxidant activity differs in different plant materials and therefore the dosage in meat products differs. Berries and their extracts are rich in polyphenols and are suitable for use in meat products (*Lorenzo et al.,* 2018).

2. Materials and methods

The fruit of *Aronia melanocarpa* was provided by the Botanic Garden of Slovak University of Agriculture in Nitra. The meat (loin and shoulder) for the meat product manufacturing were bought at a local butcher shop.

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2.1 Extract preparation

According to *Jurčaga et al.* (2021), *Aronia melanocarpa* was extracted. Fruits that had been dried and homogenized (20 g) were combined with 100 mL of 80% ethanol in a shaker and allow to rest for 24 hours at room temperature and in the dark. Ethanol was added to the filtrate to a maximum volume of 100 mL. In a vacuum rotary evaporator, the liquid portion was then evaporated until dry at 65°C. Resolving the weighted dry residue in 50 mL of water. The finished extract was stored in the dark at 4°C.

2.2 Frankfurters preparation

The following materials were used for preparing the meat product: pork meat, water, a salting mixture with 0.3% sodium nitrite concentration, black pepper, sweet and sour paprika, and nutmeg. The antioxidants were then incorporated after mixing all of the ingredients together. The control group (Con) was prepared with no antioxidant additive at all. The second group (Con-C) contained 0.7 g kg^{-1} of citric acid. The third (AM-1) and the fourth group (AM-2) contained 3 mL kg^{-1} and 5 mL kg^{-1} of extracts of *Aronia melanocarpa*, respectively. The finished pork frankfurters were heat-cured by wet smoking to obtain a temperature of 70°C in the core for at least 10 minutes, cooled down, and packaged, vacuum sealed, and stored at 4°C for 21 days.

2.3 Color determination

The color of each sample was measured using a spectrophotometer (Konica Minolta CM-2600d, Osaka, Japan) set to Specular Component Included (SCI) after each sample had been homogenized. We used a 10° observer with an 8 mm-diameter port and the D65 light source. According to the manual, the white plate calibration was performed at a temperature of 23°C. The results of the experiment were represented as coordinates in the CIELab color interface, where L* indicates lightness, a* for redness-greenness, and b* for yellowness-blueness. Color measurements were made on days 1 and 21 of storage.

2.4 Texture analysis

The TA.XTplus Texture Analyzer (Godalming UK) was used as the texture analyzer machine to determine the textural characteristics. Before the analysis, the frankfurters were cooked to a core temperature of 70°C. The materials were cut into 1 × 1 cm blocks before analysis. With a Warner-Bratzler probe (V-blade) chosen from the analyzer library, we used the default settings for the hot-dog analysis. We observed the firmness and toughness measurements. Texture analysis measurements were made on days 1 and 21.

2.5 Sensory evaluation

A professional panel performed the sensory evaluation on days 1 and 21 after preparation. Before the evaluation, all of the samples were heated. Five sensory parameters were observed: appearance (surface and on a cut), color, odor, consistency, and taste. Every parameter was rated on a scale of 1 to 5. A score of 5 represented the parameter's best score and 1 the worst score for each selected parameter. We calculated the arithmetic mean from the assigned values. The sensory panel was made up of 10 trained evaluators, both male and female, ranging in age from 25 to 50. The Department of Technology and Quality of Animal Products provided all of the evaluators, all of whom have experience rating the quality of animal products.

2.6 Statistical analysis

ANOVA analysis with a Duncan test was performed to compare the findings of the various analysis groups. The level of significance was set to 0.05 for each test. The statistical and data analysis solution XLSTAT (Addinsoft, 2021, New York, NY, USA), was used for the analysis.

3. Results and discussion

3.1 Color analysis

Color determination of all the samples was carried out on the days 1 and 21 of storage. The main objective of our research was to observe changes between the negative control (Con. — without antioxidants) and experimental groups (Con-C, AM-1, AM-2). For the lightness parameter, on day 1, Con-C showed the highest value compared to the other groups. On day 1, there were no significant differences between the negative control and experimental groups in yellowness and redness. At the end of the storage period, on the day 21, no statistically significant differences were found in the lightness of the groups of frankfurters. For the yellowness parameter, the control with added vitamin C (Con-C) clearly showed the highest value compared to the other groups. A statistically significant difference was found in redness between the negative control (Con.) and the experimental group AM-2. *Muzolf-Panek et al.* (2015) reported that the addition

Table 1. Color analysis results of frankfurter sausages

Group	Day 1			Day 21		
	L*(D65)	a*(D65)	b*(D65)	L*(D65)	a*(D65)	b*(D65)
Con.	65.80± 1.224^{b}	12.38± 0.706^{a}	19.34± 0.896^{a}	66.11± 1.378^{a}	11.86± 0.320^{b}	18.78± 0.512^{b}
Con-C	67.69± 0.907^{a}	12.96± 0.367^{a}	19.44± 0.325^{a}	66.28± 0.923^{a}	12.72± 0.651^{a}	19.16± 0.677^{ab}
AM-1	65.70± 0.900^{b}	12.91± 0.793^{a}	19.20± 0.838^{a}	66.77± 1.062^{a}	11.65± 0.664^{b}	19.18± 0.694^{ab}
AM-2	66.77± 1.381^{ab}	12.87± 0.813^{a}	19.40± 0.690^{a}	66.62± 0.867^{a}	12.17± 0.564^{b}	19.82± 0.576^{a}
p-value	0.002	0.277	0.900	0.544	0.002	0.011

Note: Con.= negative control, Con-C= control with 0.7 g kg^{-1} vit. C, AM-1= 3 mL chokeberry extract, AM-2= 5mL chokeberry extract, results are expressed as value ± S.D.; L* = measured lightness, a* = measured redness, b* = measured yellowness, D65-standard illumination used for measurement; a, ab, b as upper index represent statistically significant differences between groups in columns.

of blueberry extract caused a significant decrease in the values of the L* parameter, which results from the dark blue color of blueberries. Similar findings were reported by *Garrido et al.* (2011), *Selani et al.* (2011) and *Jia et al.* (2012) after the addition of grape and blackcurrant extracts. The blueberry extract also caused a significant reduction in the redness of the pork loin compared to the control sample. The b* parameter was also affected by the addition of blueberry extract, which significantly reduced the yellowness of pork meatloaf. Similar to our study, *Muzolf-Panek et al.* (2015) reported that the parameter b* was affected after the addition of blueberry extract, which significantly reduced the yellowness of the pork cutlet.

3.2 Textural analysis

The textural analysis of all the samples was carried out on days 1 and 21 of storage. All samples were cut into 1 × 1 cm squares. The objective of our study was to find out whether the addition of the extract would have an impact on the final meat

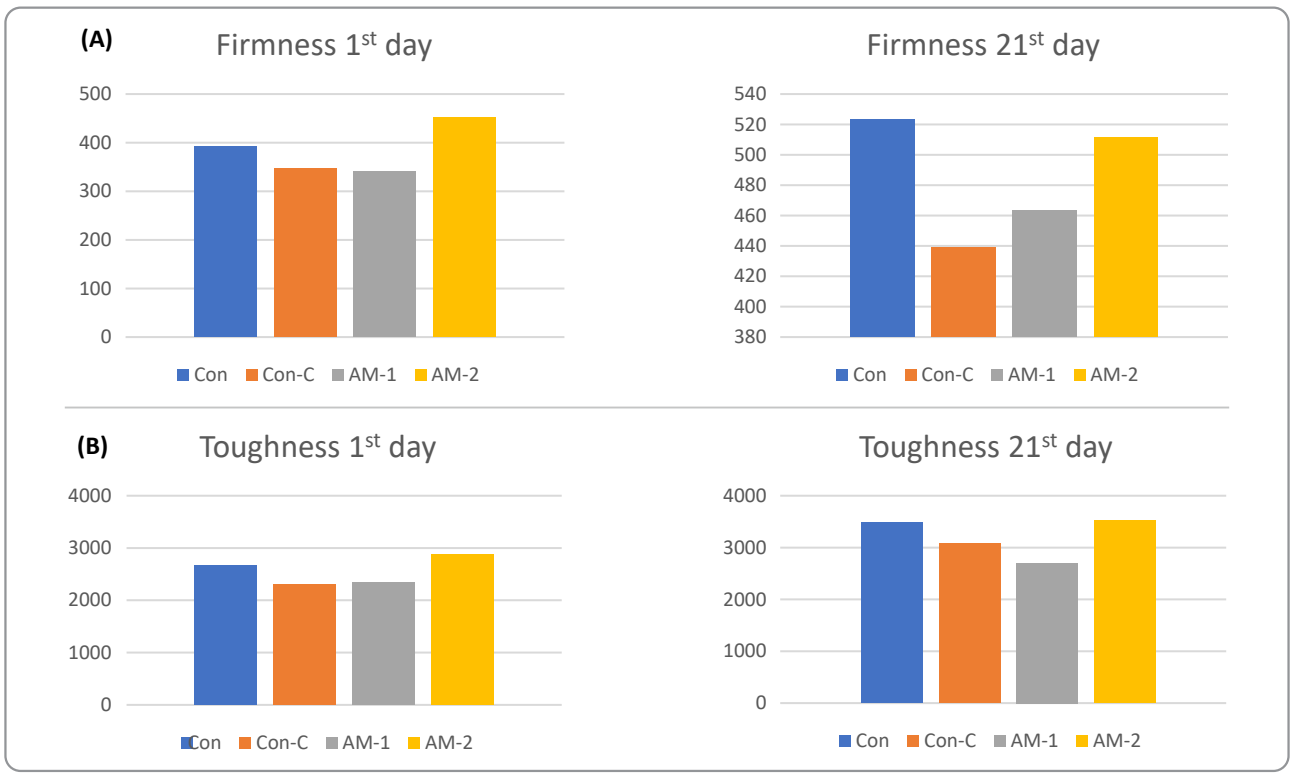

Figure 1. (A) Results of textural analysis of frankfurter sausages — Firmness (g); **(B)** Results of textural analysis of frankfurter sausages — Toughness (g.s)

Note: Con.= negative control, Con-C= control with 0.7 g kg^{-1} vitamin C, AM-1= 3 m L chokeberry extract, AM-2= 5 mL chokeberry extract, a, ab, b as upper index represent statistically significant differences between groups on each day of measurement.

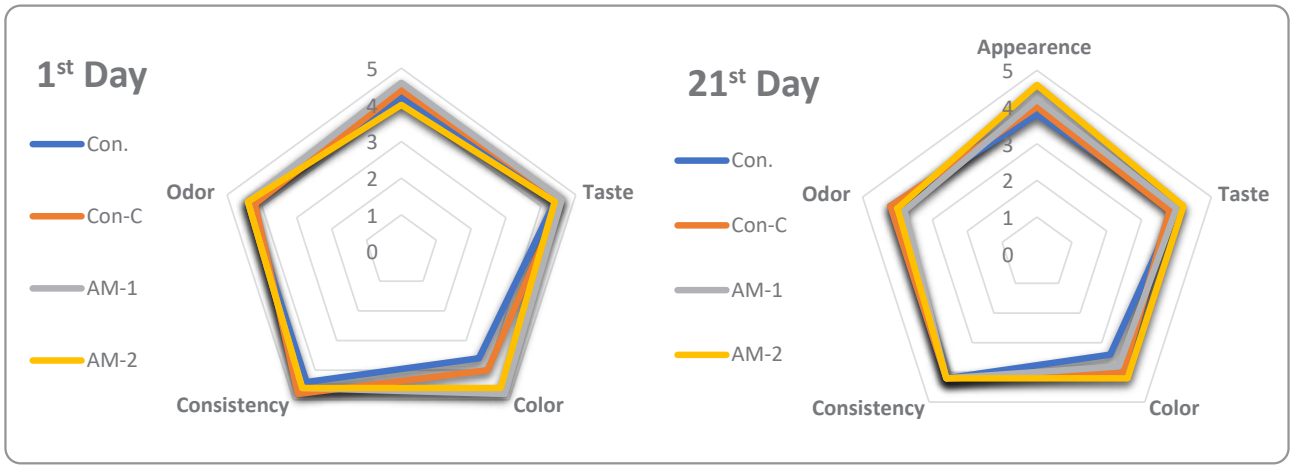

Figure 2. Results of sensory evaluation for frankfurter sausages

product's firmness and toughness over the course of storage. At the beginning of the storage period, the highest values of firmness and toughness were measured in the experimental group AM-2 compared to the other groups. After 21 days of storage, no statistically significant differences between the groups were demonstrated in firmness or toughness. The observed differences between the analyzed groups could be due to the technological procedure of dough filling rather than the addition of antioxidants. *Jurčaga et al.* (2021) in their analysis noted no significant differences in strength between all groups during the storage period. They noted a significant difference in the toughness parameter between the negative control and the groups with the addition of antioxidants.

3.3 Sensory evaluation

Possibly the most important factor in determining customer satisfaction is the product's sensory quality. Any experimental addition cannot affect quality indicators like taste or odor. Our objective was to monitor changes in the chosen parameters over the period of storage. After the first day of storage, the most favorably evaluated sample was experimental group AM-1, which achieved the highest average scores for appearance, taste, color and smell. This sample also achieved the best overall score. The group with the addition of vitamin C (Con-C) achieved the best scores for taste and consistency. After 21 days of storage, we observed a decrease in scores for all groups. The best rated was the experimental group AM-2, which achieved the best rating in all monitored parameters. After 1 and 21 days of storage, both experimental groups (AM-1 and AM-2) achieved satisfactory scores, indicating that chokeberry extracts can improve the sensory quality of meat products. Barberry extract was added to chicken frankfurters by *Jaberi et al.* in concentrations of 0.75, 1.5, and 3%. Additionally, in their research, the group that received 3% barberry extract had the highest color value. In an experiment with blackcurrant extract, *Jurčaga et al.* (2021) reported similar results. After adding extracts from black chokeberry, blackberry, blueberry and red currant pomace, *Babaoglu et al.* (2022) found that extracts from the pomace of various berries preserved the sensory properties of beef patties despite advances in refrigerated storage. Similar results were reported by *Turan and Şimşek* (2021), who added 0.1% and 0.2% black mulberry water extract and found that the extracts did not affect the color, texture, aroma or taste scores of cooked beef patties.

4. Conclusion

In our study, we observed the effect of chokeberry extracts on the sensory and textural properties and color changes of frankfurters compared to a negative control and a group with vitamin C supplementation. The frankfurters were stored for 21 days in vacuum packaging and were kept in a refrigerator. During the storage of the products, we did not observe any negative effects of the added extracts on the textural properties and color changes. During the sensory evaluation at the end of the storage period, the experimental groups with a higher amount of extract showed the best point evaluation in appearance, taste, color and consistency. From the findings, chokeberry extracts seem to be suitable as natural antioxidants in meat products, but further experiments would be necessary.

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