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SENSORIAL EVALUATION OF PORK MEAT SAUSAGES ENRICHED WITH CHOKEBERRY (*Aronia melanocarpa*) AND BLUEBERRY (*Vaccinium myrtillus*) POWDERS

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Abstract

Sensory characteristics evaluation (appearance, colour, smell, taste, texture) represents the most important criterion in the purchase decision of meat products. The aim of the study was to produce and sensory evaluate seven batches of pork meat sausages (control, sausages+chokeberry powder in concentration of 1.2%, 2.5%, 5% and sausages+blueberry in concentration of 1.2%, 2.5%, 5%). The plant-based powders were added to improve shelf-life of the products and the sensorial assessment was used to choose the best concentration in terms of consumers´ acceptance. The evaluation involved completing an acceptability questionnaire using a 9-point hedonic scale, an acceptability test with scores on the general attributes of appearance, texture, aroma, taste, overall quality. The most favourable responses were recorded for the sausages with 2.5% chokeberry, followed by the sausages with 1.2% chokeberry. As an important feature, it is the colour change, appreciated by consumers. The most unfavourable responses were received following the evaluation of the sausage samples with 5% blueberry extract which gave a sweet taste uncharacteristic of meat products.

Key words*: blueberry powder, chokeberry powder, pork meat sausages, sensorial evaluation.*

INTRODUCTION

Meat and meat products represent an important source of protein and the current trends in food safety are focused on preserving the nutritional quality by replacing the synthetic antioxidants with natural antioxidants (Petcu et al., 2023; Shah et al., 2014). Consumers are more and more interested in what they eat, so the meat industry has orientated towards using successful combinations of functional ingredients in order to obtain satisfactory sensory attributes (Hosseini et al., 2014; Miller, 2017). Sensory characteristics evaluation (appearance, colour, smell, taste, texture) represents the one of most important criterion in the purchase decision of meat products (Figure 1). Consumers´ acceptance is evaluated through hedonic tests to assess the overall liking and degree of liking for individual sensory attributes (Fiorentini et al., 2020). The aim of this study was to use the plant-based powders in order to improve shelf-life of the products and the sensorial assessment was used to choose the best concentration in terms of consumers´ acceptance.

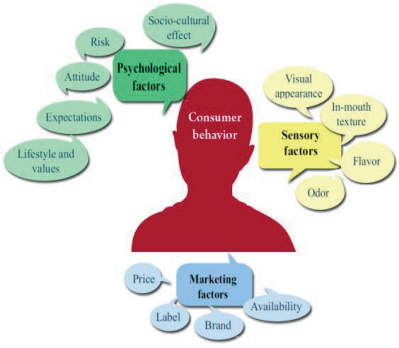

Figure1. Multicriterial decision in consumer behaviour (adapted from Font-i-Furnols & Guerrero, 2014)

MATERIALS AND METHODS

The seven experimental batches of pork meat sausages were obtained in controlled conditions in the Faculty of Veterinary Medicine of Bucharest. The first batch (B1), considered being the control, contained pork, spices: coriander, garlic, basil, thyme, black pepper, white pepper, salt and sugar in different proportions. The other six batches had the same composition, but chokeberry and blueberry powders were added in different concentration as presented in Table 1.

Table 1. Composition of experimental batches

Batch	Specification
B1	control
B2	control+chokeberry powder 1.2%
B3	control+chokeberry powder 2.5%
B4	control+chokeberry powder 5%
B5	control+ blueberry powder 1.2%
B6	control+ blueberry powder 2.5%
B7	control+ blueberry powder 5%

The manufacturing process involved meat mincing, salting and seasoning, baking in the oven (T = 190°C, t = 40 min).

The sensorial evaluation was done by 37 students, aged between 22 and 24 years, trained in advance regarding specific sensory terms and organization of the tasting session.

The sausages were sliced in pieces of equal sizes, encoded and distributed to evaluators.

The evaluation involved fulfilling an acceptability questionnaire using a 9-point hedonic scale, with parameters between 1 (extremely pleasant) and 9 (extremely unpleasant) and an acceptability test with scores on the general attributes of appearance, texture, smell, taste (Meilgaard et al., 2016).

One-way ANOVA test was used to assess significant differences between independent experimental groups. This method helps in determining the existence of significant variations between groups depending on the independent variable being tested. The significance level chosen was 0.05. If the analysis was significant ($p<0.05$), the Tukey-Kramer test was used as a post-hoc test to compare the means of the groups and identify significant differences between them. In the situation in which the data did not show a normal distribution (by Shapiro-Wilk test) and/or did not meet the requirements for the application of the one-way ANOVA analysis, the non-parametric Kruskal–Wallis test was used and the multiple comparison graphs were made for a graphical representation of this test. It was followed by a post hoc analysis using the non-parametric Conover test.

RESULTS AND DISCUSSIONS

Hedonic analysis

Following the hedonic analysis with a 9-point scale (1-extremely pleasant, 2-very pleasant, 3-pleasant, 4-slightly pleasant, 5-neutral, 6-slightly unpleasant, 7-unpleasant, 8-very unpleasant, 9-extremely unpleasant), consumers' perception through the Kruskal–Wallis test (P = 0.000019) tends to consider B1 being very pleasant, followed by B2, B3, B5, and B6 as pleasant, and slightly pleasant B4 and B7 (Figure 2).

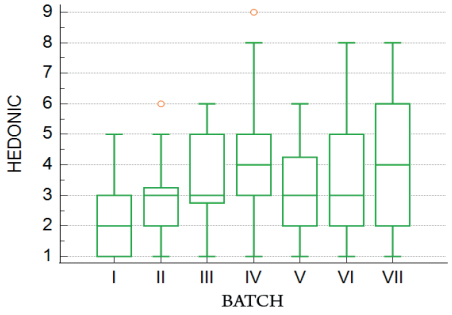

Figure 2. Multiple comparison graph - Hedonic analysis

The non-parametric Conover test reveals the differences among the batches as follows in Table 2.

Table 2. Differences among batches by hedonic analysis

Batch	n	Different(P<0,05) from batch no.
B1	37	B3, B4, B5, B6, B7
B2	37	B4, B7
B3	37	B1
B4	37	B1,B2,B5
B5	37	B1, B4, B7
B6	37	B1
B7	37	B1, B2, B5

Acceptability test

Assessing consumer perception of colour shade

According to the Shapiro-Wilk test, the data collected regarding the assessment of consumers' perception of colour-shade obtained

in the experiment for the seven batches, were not normally distributed (P = 0.0216). At the same time, according to the significance level of the non-parametric Kruskal-Wallis test (P<0.000001), there are no significant differences between the researched batches. However, there is a variability in the data, pink shade is present at batches B1 and B2 followed by an increasing in colour intensity for B5, B3, and B6 and the most intense colour burgundy B4 and B7 (Figure 3).

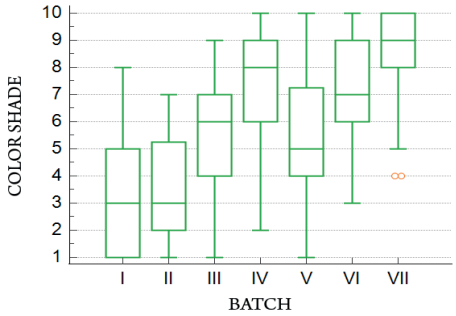

Figure 3. Multiple comparison graph - colour shade

The differences between batches using Conover test are presented in Table 3.

Table 3. Differences among batches colour-shade

Batch	n	Different (P<0.05) from batch no.
B1	37	B3, B4, B5, B6, B7
B2	37	B3, B4, B5, B6, B7
B3	37	B1, B2, B4, B6, B7
B4	37	B1, B2, B3, B4, B5, B7
B5	37	B1, B2, B4, B6, B7
B6	37	B1, B2, B3, B5, B7
B7	37	B1, B2, B3, B4, B5, B6

Assessing consumer perception - colour intensity

The data collected for this parameter were not normally distributed, Shapiro-Wilk test revealed P<0.0001.

On the colour intensity scale (1 - imperceptible, 2 - perceptible, 3 - intense), it was found that the samples belonging to B7 had the highest intensity (Figure 4).

According to the significance level of the non-parametric Kruskal-Wallis test (P = 0.003216), there are no significant differences between the researched batches.

The non-parametric Conover test reveals the differences among the batches as follows in Table 4.

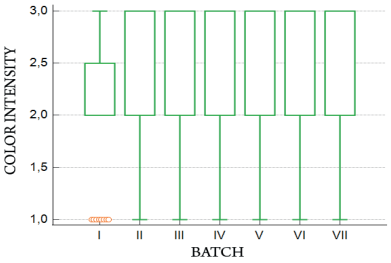

Figure 4. Multiple comparison graph - colour intensity

Table 4. Differences among batches colour-intensity

Batch	n	Different (P<0.05) from batch no.
B1	37	B4, B5, B6, B7 (4) (5) (6) (7)
B2	37	B6, B7
B3	37	B7
B4	37	B1
B5	37	B1
B6	37	B1, B2
B7	37	B1, B2, B3

Assessing consumer perception of taste intensity

The Shapiro-Wilk test revealed P<0.0001 and according to the significance level of the non-parametric Kruskal-Wallis test (P = 0.007257) there are no significant differences between the batches. B1 was considered to have the most pleasant intensity of the taste, meanwhile the other six batches obtained pleasant intensity taste (Figure 5).

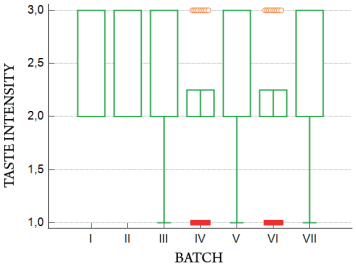

Figure 5. Multiple comparison graph - taste intensity

The non-parametric Conover test reveals the differences among the batches as follows in Table 5.

Table 5. Differences among batches taste-intensity

Batch	n	Different (P<0.05) from batch no.
B1	37	B4, B5, B6, B7
B2	37	-
B3	37	-
B4	37	B1
B5	37	B1
B6	37	B1
B7	37	B1

Assessing consumer perception - dominant taste

From the four perceptible tastes (1-fat, 2-meat, 3-spices, 4-other tastes), consumers specified that the dominant taste is of meat for batches 1, 2, and the other batches especially the taste of spice. According to the Shapiro-Wilk test, the data collected regarding the assessment of consumers' perception of dominant taste obtained in the experiment for the seven batches, were not normally distributed (P<0.0001). At the same time, according to the significance level of the non-parametric Kruskal-Wallis test (P = 0.030745), there are no significant differences between the researched batches (Figure 6).

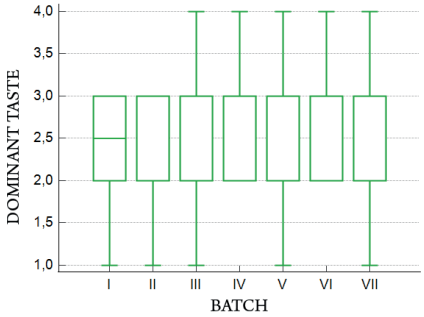

Figure 6. Multiple comparaison graph - dominant taste

The non-parametric Conover test reveals the differences among the batches as follows in Table 6.

Table 6. Differences among batches - dominant taste

Batch	n	Different (P<0.05) from batch no.
B1	37	B4
B2	37	B3, B4, B5
B3	37	B2
B4	37	B1, B2
B5	37	B2
B6	37	-
B7	37	-

Assessing consumer perception - dominant smell

By applying Shapiro-Wilk test the result for P was <0.0001 and according to the significance level of the non-parametric Kruskal-Wallis test (P = 0.522376), there are no significant differences between the researched batches. However, it can be seen that for batches 2, 3 and 4 the dominant smell was of meat and for batches 1, 5, 6 and 7 of spices (Figure 7).

The non-parametric Conover test showed that there were no differences between batches.

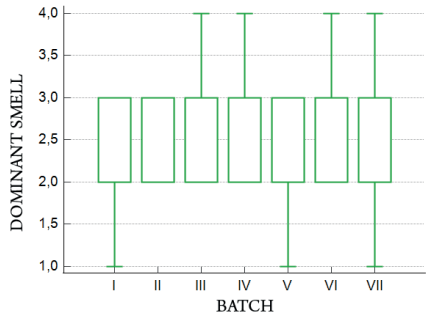

Figure 7. Multiple comparison graph - dominant smell

Assessing consumer perception - smell intensity

For this parameter, the Shapiro-Wilk test had a value of P<0.0001, so the seven batches had values not normaly distributed. At the same time, according to the significance level of the non-parametric Kruskal-Wallis test (P = 0.179158), there are no significant differences between the researched batches (Figure 8). The non-parametric Conover test showed that there were no differences between batches. All the batches had pleasant smell intensity.

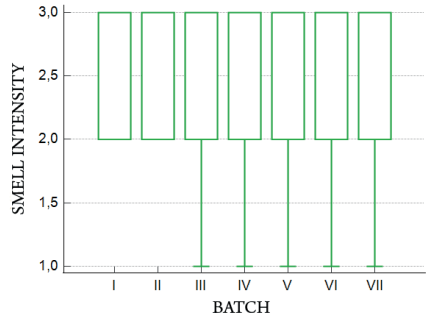

Figure 8. Multiple comparison graph - smell intensity

Assessing consumer perception - consistency friability

The scale used for this parameter was 1 -slightly crumbly, 2 - crumbly, 3 - very crumbly and the results showed that B1 and B2 were slightly crumbly and B3-B7 were crumbly.

The Shapiro-Wilk test showed an abnormal distribution (P<0.0001) and Kruskal-Wallis test (P = 0.064087), there are no significant differences between the researched batches (Figure 9).

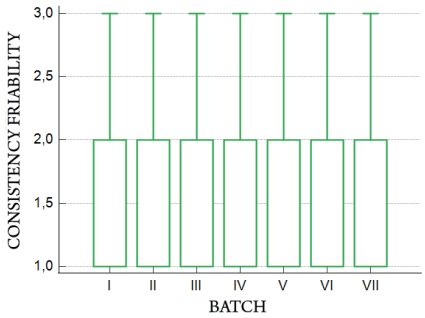

Figure 9. Multiple comparison graph - consistency friability

The non-parametric Conover test showed that there were no differences between batches.

Assessing consumer perception - juicy consistency

The batches B1, B3, B4, B6 and B7 were included in the slightly juicy category and B2 and B5 in juicy category. The Shapiro-Wilk test showed an abnormal distribution (P<0.0001) and Kruskal-Wallis test (P = 0.111378), there are no significant differences between the researched batches (Figure 10). The non-parametric Conover test showed that there were no differences between batches.

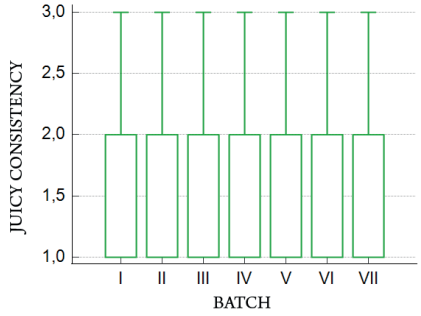

Figure 10. Multiple comparison graph - consistency friability

Assessing consumer perception - texture consistency

The Shapiro-Wilk test showed an abnormal distribution (P<0.0001) and Kruskal-Wallis test (P = 0.000791), there are no significant differences between the researched batches (Figure 10). The batches B1 and B2 had a smooth texture, meanwhile B3-B7 a hard consistency.

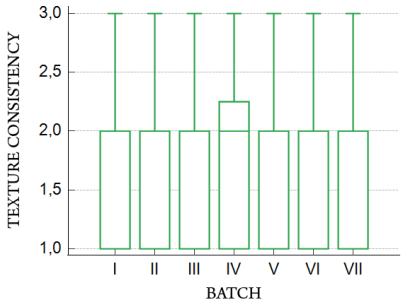

Figure 11. Multiple comparison graph - texture consistency

The non-parametric Conover test reveals the differences among the batches as follows in Table 7.

Table 7. Differences among batches texture consistency

Batch	n	Different (P<0.05) from batch no.
B1	37	B3, B4, B5, B6, B7
B2	37	B4, B6, B7
B3	37	B1
B4	37	B1, B2
B5	37	B1
B6	37	B1, B2
B7	37	B1, B2

CONCLUSIONS

After evaluating consumer perception using the 1-9 scale, although there were no significant differences between the tested treatments, there was an obvious variability in the results.

The most favourable responses were recorded for the sausages with 2.5% chokeberry, followed by the sausages with 1.2% chokeberry.

As an important feature, it is the colour change, appreciated by consumers.

The most unfavourable responses were received following the evaluation of the sausage samples with 5% blueberry extract which gave a sweet taste uncharacteristic of meat products.

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