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IMPACT OF USING DEHYDRATED FRUITS POWDER AS NATURAL ANTIOXIDANT ON SENSORY PROPRIETIES OF NITRITE-FREE SALAMI FORMULAS

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Abstract

The present study aims to evaluate the effects of dehydrated fruits powder as natural antioxidant used to substitute the nitrites in the manufacture recipe of a cooked and smoked salami type on its sensory proprieties. For this purpose were used sour cherries (SC), cranberries (C) and black currants (BC) which in advance were subjected to a dehydration process for 15 hours at a moderate temperature of 55-60°C, 5 hours daily, three days in a row. The powder obtained from each dehydrated fruit was used at three levels of concentration in order to ensure a dose of polyphenolic compounds equally with 90, 200 and 300 mg gallic acid equivalents (GAE)/kg raw processed meat. The minimum dose of polyphenolic compounds coming from dehydrated fruits powder was chosen according to the nitrites content added to a kg of raw minced meat (90 mg nitrites/kg processed meat). Thus, nine salami formulas were prepared by addition of SC, C and BC powder at the three established concentrations. The sensory properties such as appearance, taste, odor, aroma of designed salami formulas were investigated in relation with those of the salami control samples prepared with the nitrites addition, respectively without nitrites. The substitution of nitrites by dehydrated fruits powder led to changes in the section appearance of obtained salami formulas, whereas the taste, odor and aroma were not affected. The information derived from this study is useful for the development of innovative nitrite-free meat products, in accordance with the consumer requirements, by exploiting the bioactive potential of some local fruits.

Key words*: cranberries and black currants, dehydrated fruits powder, natural antioxidants, nitrite-free salami formulas, sensory properties, sour cherries.*

INTRODUCTION

Since the middle of the last century , the food industry start to use nitrite as a food additive in meat products. Its use to stabilizing the typical color of cured meat products and as an antioxidant in meat products (Dominguez-Hernandez et al., 2018; Fraqueza et al., 2021).

The International Agency for Research on Cancer (IARC) reveals that there is a relationship between the consumption of processed meats and the occurrence of colon cancer.

Therefore based on scientific knowledge of the benefits and potential health risks, the limits for addition to meat products have been set (IARC Working Group, 2018). In order to reduce or eliminate nitrites from meat products, alternative measures should be considered (McAfee et al., 2010; Haugaard et al., 2014).

The impact of nitrites on the sensory properties of meat products is closely connected to color stabilization due to the formation of nitrosylmioglobin by the binding of nitric oxide to the iron of that hemoprotein (Savu et al., 2002). Nitrite also participates in flavoring through its antioxidant action (Patarata et al., 2022).

To guarantee the strategy's efficacy when we reduce or eliminate nitrate from meat products

during manufacture, we must consider an alternative measure (Papuc et al., 2013; Predescu et al., 2018).
The stabilization of color due to the formation of nitrosylmyoglobin by the bond of nitric oxide with the iron of that hemoprotein is mainly related to the effect of nitrite on meat products' sensory attributes (Huang et al., 2020).
Sodium nitrite is an additive that fulfills several functions, among which the hardening of the meat, offers a unique pink-reddish color and aroma, prolongs the shelf life of the products and provides microbiological safety. However, there has been a high consumer demand for low-nitrite or nitrite-free products (Engel et al., 2004; Pogorzelska-Nowicka et al., 2014; Wakamatsu et al., 2020).
A partial or total substitute of nitrite in meat products with a natural antioxidant would be a valuable choose, without compromising the sensory attributes of the products (Stoica et al., 2022). Also, an alternative is to use packaging in a controlled atmosphere (Petcu et al., 2014).
A major problem that decreases the shelf life of meat products is oxidation, and nitrite as a synthetic compound is used to delay oxidation reaction, but also natural bioactive components can be used instead synthetic compounds (Jiménez-Colmenero et al., 2001; Kamala et al., 2019).
Natural sources with antioxidants compounds that can be used in meat products are plants, herbs and spices extract, fruits and vegetables, and oilseeds (Vitaglione et al., 2008; Khan et al., 2010; Metzner Ungureanu et al., 2020; Raba et al., 2020).
Nowadays the association of fruits with meat products shows major interest to the meat industry, fruits as natural antioxidants, manage to improve sensory properties and improve biologically active properties (Jiménez et al., 2001; Popa et al., 2011; Raba et al., 2021).
Nour (2022) used sour cherry and plum juice marinades on pork loin to study the effects of these fruits on quality characteristics and oxidative stability. The results shows that sour cherry and plum juice may be used as marinating ingredients as they promote interesting sensory proprieties and improve the storage stability of porc loin.
Lee et al. (2006) reveal that cranberry powder in addition with mechanically separated turkey and ground cooked pork reduced TBARS values by 81% over a storage period of 7 days at 2ºC in the cooked pork and by 84% over a period of 6 days at 2ºC in the mechanically separated turkey.
Jia et al. (2012) indicated that antioxidant activity of black currant extract in raw pork patties, significantly increase lipid and protein oxidation during chilled storage.
Cranberries have many phenolic compounds such as phenolic acids, flavonoids, anthocyanins, p-hydroxybenzoic acid and their derivatives (Vattem et al., 2005; Caillet et al., 2012).
The value of mature cranberries total phenolic content are 4745 mg/kg in gallic acid equivalents and total monomeric anthocyanin content of 111.0 mg/kg (Çelik et al., 2008; Wu et al., 2008).
The antioxidant capacity of cranberries is associated with their phenolic and anthocyanin-anthocyanidincontents.
Taking into consideration the mentioned data, the aim of this study was to evaluate the effects of three dehydrated fruits powder addition, sour cherries (SC), cranberries (C) and black currants (BC), in order to substitute the nitrite in the recipe of a cooked and smoked salami type on its sensory proprieties.

MATERIALS AND METHODS

Fruit powder obtaining

The fruits used in this study, sour cherries (SC), cranberries (C) and black currants (BC), were dehydrated at a moderate temperature of 55-60°C in a forced air oven (Froilabo AC60/France, 1000 W), for 15 hours, 5 hours daily, three days in a row. The dehydration process allows the fruit bioactive compounds preservation. The dried fruits were ground in a laboratory mill (Grindomix Retsch GM 2000), then, passed through a 60 mesh sieve. The obtained fruit powders were used as a nitrite substitut in salami formulas.

Evaluation of total phenolics content of fruits powder

The total phenolics content in the fruits powder was assessed using the Folin-Ciocalteu colorimetric method (Singleton et al., 1999). The evaluation of total phenolics content was performed on the extract obtained as follows: 1 g fruits powder was mixed with 10 mL ethyl alcohol, 70% (v/v) under stirring for 1h, at a temperature of 25°C using the horizontal shaker Heidolph Promax 1020 (Germany). The mixtures were filtered and the resulted fractions were used for analysis. The absorbance was measured at 750 nm using the gallic acid as a standard.

The determinations were performed in triplicates and the results, were expressed as mg gallic acid equivalents (GAE)/g dry weight (d.s). The polyphenol content of fruits powder was reported as average value ± standard deviation.

Establishing the dehydrated fruit doses

The powder obtained from each dehydrated fruit was used at three levels of concentration in order to ensure a dose of polyphenolic compounds equally with 90, 200 and 300 mg gallic acid equivalents (GAE)/kg raw minced meat. The minimum dose of polyphenolic compounds coming from dehydrated fruits powder was chosen according to the nitrites content added to a kg of raw minced meat (90 mg nitrites/kg minced meat).

Salami formulas preparation

The preparation of the salami is done strictly respecting the manufacturing stages, weighing the raw material, weighing the auxiliary material, mixing the raw material by adding the auxiliary material, filling in membranes, heat treatment and storage.

At the mixing stage, SC, C, BC fruit powders were added at three levels of concentrations 90, 200, 300 mg GAE/kg in raw minced meat in order to replace the nitrite.

The nitrite-free salami formulas were investigated in relation with those of the salami control samples prepared with the nitrite addition, respectively without nitrite.

The salami samples were cooked and smoked in a smocking cell with a closed smoke flap according to a technological diagram, until it reached 62°C in the technological center of the product.

After cooling the salami formulas were stored in refrigeration conditions, 2-4°C, for 21 days until the sensorial analyzes were performed. The sample coding is shown in Table 1.

Table 1 Sample coding

Sample name	Code
Salami control sample with nitrite	CS
Nitrite-Free Salami control sample	NFCS
Nitrite-Free Salami with SC powder to ensure a polyphenol content of 90 mg GAE/kg raw minced meat	1SC
Nitrite-Free Salami with SC powder to ensure a polyphenol content of 200 mg GAE/kg raw minced meat	2SC
Nitrite-Free Salami with SC powder to ensure a polyphenol content of 300 mg GAE/kg raw minced meat	3SC
Nitrite-Free Salami with C powder to ensure a polyphenol content of 90 mg GAE/kg raw minced meat	1C
Nitrite-Free Salami with C powder to ensure a polyphenol content of 200 mg GAE/kg raw minced meat	2C
Nitrite-Free Salami with C powder to ensure a polyphenol content of 300 mg GAE/kg raw minced meat	3C
Nitrite-Free Salami with BC powder to ensure a polyphenol content of 90 mg GAE/kg raw minced meat	1BC
Nitrite-Free Salami with BC powder to ensure a polyphenol content 200 mg GAE/kg raw minced meat	2BC
Nitrite-Free Salami with BC powder to ensure a polyphenol content 300 mg GAE/kg raw minced meat	3BC

Sensory characteristics evaluation

A key criterion for the successful using of fruit powder in a food system is whether the sensory properties of the food are not adversely affected. Finally, the quality and desirability of a food product is determined by the reaction of consumers to the appearance, taste and smell of food. For this reason, the sensory properties of new or improved foods are usually tested using human taste panels to ensure that foods have acceptable and desirable properties before they are placed on the market (Lawless & Heymann, 2010).

Foods are often tested using consumer panels, large groups of untrained consumers, to determine their reaction to an improved new product before completing large-scale marketing for further development, or alternatively select trained persons to be able to reliably detect small differences in specific qualities of certain foods.

The sensory analysis was performed using the hedonic scale method (STAS 12656-88), for salami, using a group of 10 tasters.

The sensory characteristics evaluated were appearance, taste, odor and aroma, thus the scores that were assigned for each characteristic ranged from 0-5, by comparison with sample formulas. A maximum of 20 points must be obtained by summing the maximum approved score for each sensory characteristic. Each taster assigns a score to a sensory characteristic of one sample, and then a medium score is made. The sum of the medium scores of the 4 characteristics analyzed for an analysis test leads to the formation of the total medium score. Each sample has a total medium score, which helps us to identify which concentration level of the added fruit powder is better to ensure the optimal level of natural antioxidant, but also which is the best fruit of the three analyzed SC, C, BC as a substitute for nitrite.

RESULTS AND DISCUSSIONS

The total phenolic content recorded in the investigated fruits powder in order to calculated the doses incorporated in the manufacture recipes were in the range 10- 16 mg GAE/g d.s, as is shown in Table 2.

Table 2. Total phenolic content of fruits powder

Fruits powder	Total phenolic content (mg GAE/g d.s)
SC	10.01±0.28
C	12.36±0.34
BC	16.01±0.42

The salami formulas obtained by SC powder incorporation are presented in Figure 1.
The highest score (19.6) was recorded for the CS formula, and respectively the lowest score (12.6) was recorded for NFCS.
Analyzing the addition of SC powder, the highest score was recorded for 1SC (15.9), followed by 2SC (15.7), and the lowest score was registered for 3SC (15.3).
In terms of appearance, the highest score was recorded for the 1SC, followed by 2SC and the lowest score was obtained for 3SC. The smell and aroma did not change significantly.
Another sensory characteristic that had a slight influence is the taste that had decreasing values as the amount of SC increased.
As a result, the values of the total scores of the samples with SC added (1SC, 2SC, 3SC) were the lowest compared to the other fruits C and BC, respectively, due to the values of the medium scores of the salami appearance, the SC granulation offers a less acceptable appearance (Figure 1).
The salami formulas obtained by C powder incorporation are presented in Figure 3 and the sensory analysis results of prepared formulas against control samples are displayed in Figure 4. The highest score is the 3C (18.5) sample, followed by 2C (18.3) and the lowest 1C score (17.8). The scores recorded for the salami formulas were in the range of 12.6-19.6, as can be seen in Figure 2.

CS

NFCS

1SC

2SC

3SC

Figure 1. Salami control samples
and salami formulas with addition of SC

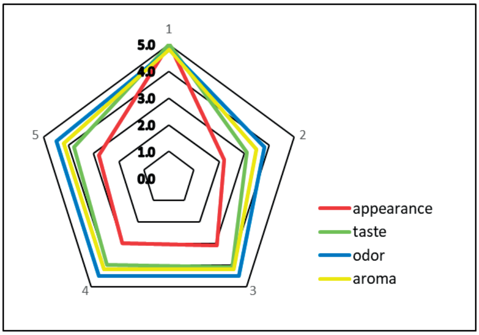


Figure 2. The sensory analysis results of salami with SC against control samples
(1-CS, 2-NFCS, 3-1SC, 4-2SC, 5-3SC)

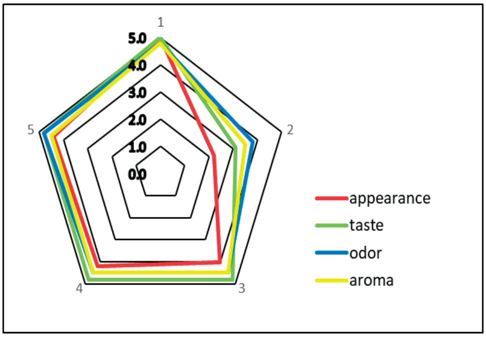
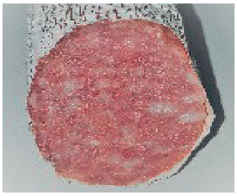


Figure 4. The sensory analysis results of salami with SC against control samples
(1-CS, 2-NFCS, 3-1C, 4-2C, 5-3C)



CS

NFCS

1C

2C

3C

Figure 3. Salami control samples and salami formulas with C added

At the sensory analysis of the appearance, the highest value was registered at the salami sample 3C (4.4) respectively 2C (4.2) and the lowest value 1C (4.0), and these can be observed in Figure 3. The other sensory features did not undergo significant changes (Figure 4).

The salami formulas obtained by BC powder incorporation are presented in Figure 5 and the sensory analysis results of prepared formulas against control samples are displayed in Figure 6.

The salami formulas prepared with BC addition recorded the highest values in the 3BC samples (17.3), followed by 2BC (17.2) and the lowest value 3BC (16.8).

A sensory characteristic that has undergone slight changes is the appearance, with a medium score of 4.0 for the 1BC sample, 4.2 for the 2BC sample, and 4.3 for the 3BC sample (Figure 5). The other characteristics, has no significant changes.

The results of the sensory evaluation have the highest values of the total medium scores, compared to the other fruits proposed in this paper, SC respectively BC.

As a result of the sensory analysis performed for the 9 salami samples, the highest total but also individual score for each characteristic was obtained for the 3C sample (Figure 6).

The addition of C in the highest concentration level (300 mg GAE/kg raw processed meat), best fulfills the role of natural antioxidant as a substitute for nitrite, having a color as close as possible to the control test with nitrite (CS), without negatively influencing the other sensory aspects of salami.

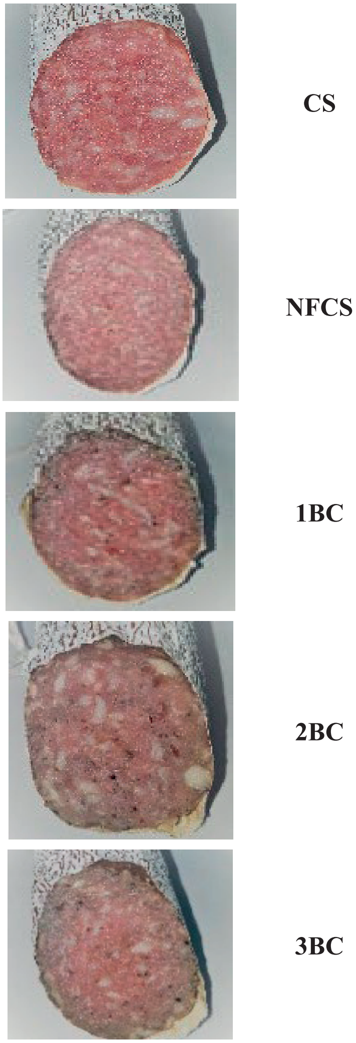


Figure 5. Salami control samples and salami formulas with BC added

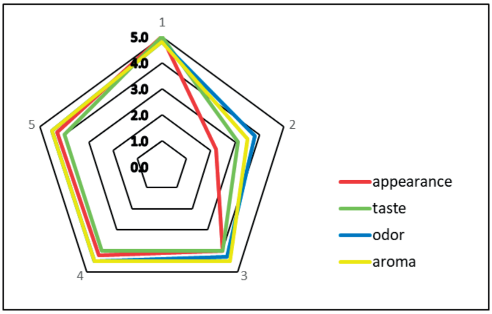


Figure 6. The sensory analysis results of salami with SC against control samples
(1-CS, 2-NFCS, 3-1BC, 4-2BC, 5-3BC)

CONCLUSIONS

Beyond the effects of improving the nutritional and sensory properties of meat products, the addition of fruit can lead to unwanted changes, which limits the application of fruit in certain categories of food. In addition to the changes of the appearance of salami, the inclusion of fruit powder in their manufacturing recipe may induce other changes in sensory properties, such as the generation of the sour taste. The results of sensory analysis of salami with dehydrated and ground fruits indicates that all three fruits sour cherries, blackcurrants and cranberries, can partially and even completely replace the nitrite added in the initial recipe. The best values are the samples with the addition of cranberries, followed by blackcurrants and sour cherries. We consider that the tested fruits can be used as natural antioxidants to create nitrite-free meat products in accordance with the consumer requirements.

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STAS 12656-88, Food products. Sensory analysis. Scoring methods.

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