



## EFFECT OF GRAPE SEED EXTRACT ON QUALITY OF RAW-COOKED MEAT PRODUCTS

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### ABSTRACT

In the present study we aimed to evaluate the oxidative stability of Spiš frankfurters after application of grape seeds extracts (Blauburger + Cabernet Sauvignon and Danube) in amount of 10 mL.kg<sup>-1</sup> during 12 days of their storage at 4 °C. Sensory evaluation of Spiš frankfurters was carried out after 4 days of storage by 6-point ranking system (Surface appearance and color, appearance and color when cut, texture, aroma and flavor). It was found that sensory quality of Spiš frankfurters was not significantly ( $p > 0.05$ ) affected by application of grape seed extracts. Oxidation stability of Spiš frankfurters after 12 days of storage at 4 °C was positively influenced ( $p \leq 0.05$ ) only in the group with addition of extract made from grape seed Blauburger + Cabernet Sauvignon. This may probably related with the higher antioxidant activity of extract of this variety (100.5%) compared to an extract made from grape seed variety of Danube (55.8%). Also, it was not found significant differences ( $p > 0.05$ ) of antioxidant activity between extract made from grape seeds variety Danube compared with the control group.

**Keywords:** grape seed; extract; Spiš frankfurter; oxidative stability; sensory quality

### INTRODUCTION

The lipid oxidation is one of the major problems in meat industries. Meat products that are constituted of lipid and polyunsaturated fatty acids (PUFAs) tend to deteriorate due to lipid oxidation, leading to development of unpleasant flavours during processing and storage (Sanchez-Moreno et al., 1999; Mielink et al., 2006). In addition to the undesirable quality, the adverse effect of lipid oxidation leads to the development of free radicals which are involved in diseases and a range of disorders including cancer, arthritis, atherosclerosis, Alzheimer's disease, and diabetes. To prevent lipid oxidation in meat products, synthetic antioxidants can be used. However, synthetic antioxidants such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) have been shown to be carcinogenic and have, thus, restricted use in foods (Baydar et al., 2007).

In the past few years, various plant materials containing phenolic compounds have been demonstrated to be effective antioxidants in model systems. Flavonoids, the most potent antioxidative compounds of plant phenolics occur in vegetables, fruits, berries, herbs, and tea leaves (Wrolstad and Skrede, 2002).

According to the estimates provided by the Organisation Internationale de la Vigne et du Vin (OIV), annual process of grapes is estimated at around 66.5 million tonnes, with 38 million tonnes produced in Europe. At

European level, the grape pomace production is about 8 million tonnes per year in total (Burg et al., 2014).

A significant part of the grape pomace is comprised by grape seed which amounts to 38 – 52% on dry matter basis (Maier, 2009).

Among the beneficial effects of parts of a grape, grape seeds are believed to have a powerful antioxidant property due to its rich source of polyphenol compounds. The polyphenol compounds in grape seeds are in range of 60 – 70%, only 10 % is in the fruit, and 28 – 35% in the peels (Garcia-Marino et al., 2006; Nawaz et al., 2006).

It is likely that the demand for using natural antioxidants such as grape seed extract (GSE) has greatly increased in recent years. GSEs are substantially constituted with proanthocyanidins. They can react with free radicals and catalyzed metal ions necessary for the oxidation reaction then terminate chain reactions by removing radical intermediates, and inhibit other oxidation reactions by being oxidized themselves (Shahidi and Wanasundara, 1992; Sanchez-Moreno et al., 1999). The phenolic substances in GSE ranges from 80% to 99%, the most important being resveratrol (trans-3,4',5-trihydroxystilbene). Due to the strong antioxidant activity of resveratrol, it can inhibit peroxidation in a concentration-dependent manner. It does not scavenge hydroxyl radical nor does it react with H<sub>2</sub>O<sub>2</sub>, making it an

inefficient catalyst of subsequent oxidation (Murcia and Martinez-Tome, 2001).

In addition, GSE is rich in proanthocyanidins. The multiple mechanisms of their antioxidative activity are expressed in its ability of radical scavenging, metal chelation, and synergism with other antioxidants (Lu and Foo, 1999).

Based on the findings of many researches (Lau and King, 2003; Mielnik et al., 2006; Ahn et al., 2007; Goni et al., 2007; Brenes et al., 2010; Tekeli et al., 2014; Iqbal et al., 2015; Lichovnikova et al., 2015; Tournour et al., 2016; Guerra-Rivas et al., 2016; Brenes et al., 2016), application of grape pomace has been shown to exert a positive effect on animal products, such as improving the carcass parameters in chickens, oxidation stability and storage of meat products, egg production (Sahin et al., 2010; Kara and Kocaoglu-Guclu, 2012; Kara et al., 2016), and in raw-cooked meat products (Özvural and Vural, 2011; Özvural and Vural, 2013; Ryu et al., 2014).

The present study aimed to determine the effect of GSE application on quality (oxidative stability, sensory quality) of raw-cooked meat products (Spiš frankfurters) stored at 4 °C.

## MATERIAL AND METHODOLOGY

The tested raw-cooked meat products (Spiš frankfurters) were made from pork meat and additional raw materials purchased at a market and processed according to the recipe for the product type (Table 1). Three groups of meat products were evaluated. The groups were formed on the basis of various additions of GSE during the mixing in a bowl cutter, as follows:

- control group (C),
- experimental group 1 (E1): 10 ml of GSE Blauburger and Cabernet Sauvignon per 1 kg of meat mixture,
- experimental group 2 (E2): 10 ml of GSE Dunaj per 1 kg of meat mixture.

The GSE-treated meat product was smoked and heat-treated (temperature in a product core reached 70 °C and persisted for 10 min). After the heat-treatment, the product was cooled to 4 °C. Meat samples were stored at 4 ±1 °C during the experimental period (12 days).

### Preparation of grape seed extract

Extraction of grape seeds was carried according to Shirahigue et al. (2010). The homogenized grape seeds (20 g) were mixed with 100 mL of 80% ethanol in a laboratory shaker in the dark and at room temperature for 24 hours. Subsequently, the liquid phase was separated from the solid phase by filtration and added into volumetric flask. The 80% ethanol was then added until a

total volume of 100 mL. After that, the liquid fraction was evaporated in the vacuum rotary evaporator at 65 °C. The dry residue was weighed and redissolved in 50 mL of distilled water. The extract was then applied into raw-cooked meat product in an amount of 10 mL per 1 kg of raw material.

### Assessment of antioxidant activity (AOA) with DPPH radical

The DPPH (2,2-diphenyl-1-picrylhydrazyl) inhibition in GSE according to method of Brand-Williams et al. (1995). The DPPH radical is used to quantify the ability of antioxidants to quench the DPPH radical. The dark purple colour of DPPH will be lost when it is reduced to its nonradical form stable organic nitrogen centred free radical with a dark purple colour which when reduced to its nonradical form by antioxidants becomes colourless. When the DPPH radical is scavenged, the colour of the reaction mixture changes from purple to yellow and decrease of the DPPH radical is measured spectrophotometrically. On the determination of AOA used which in ethanol solution is in colourless radical form. Its reduction is manifested by the change of colour of solution and is measured spectrophotometrically. Gallate was used as standard and the amount of AOA sample expressed as gallate equivalent was calculated.

### Determination of the oxidative stability

During four storage times (day 1, 4, 8, and 12), oxidative stability of meat product samples was determined according to Marciničák et al. (2010). The method is based on the rupture of lipid bilayer by free radical to form malondialdehyde (MDA) as a secondary product. Two molecules of thiobarbituric acid react with one molecule of MDA to form pink coloured product showing maximum absorbance at 532 nm called TBARS. The absorbance was measured using UV spectrophotometer (Jenway UV-VIS Spectrophotometer). The results were calculated as malondialdehyde (MDA) quantity per 1 g of sample.

### Sensory evaluation

Sensory quality of raw-cooked meat products (n = 9) after cooking (80 °C, 5 min) was assessed by five-member panel on the 4<sup>th</sup> day after processing. Sensory characteristics of meat products including surface appearance and colour, appearance and colour in cross-section, texture, aroma, and taste on a six-point hedonic scale (6 = very good, 1 = very bad).

Results of the experiment was evaluated with statistical program Statgraphics Plus version 5.1 (AV Trading Umex, Dresden, Germany), were calculated variation-statistical values (mean, standard deviation) and to determine the

Table 1 Composition of meat product (g).

Component	Amount
Pork meat	1000
Water	200
Curing salt	18
Garlic ( <i>Allium sativum</i> )	0.5
Red pepper ( <i>Capsicum annuum</i> )	6.2
Chilli pepper ( <i>Capsicum frutescens</i> )	6.2
Polyphosphate	7

significant difference between groups was used variance analyse with subsequent Scheffe test.

## RESULTS AND DISCUSSION

Antioxidant activity assessment of applied grape seed extracts of different grape varieties is shown in Table 2. In Blauburger and Cabernet Sauvignon grape varieties applied in E1 group was observed higher antioxidant activity (100.5%) than that in Cabernet Sauvignon grape variety (55.8%). Similarly, **Slezák (2007)**, **Bajčan et al. (2015)**, and **Špakovská et al. (2012)** found AA in the range of 69 – 90.9% in red wine grape varieties. In addition, similar AA values (61.4 – 87.1%) found **El-Beshbishy et al. (2009)** in red grape seed extracts.

Oxidation of meat lipids is a complex process and its dynamics depend on numerous factors including chemical composition of meat, light and oxygen access, and storage temperature. The manufacturing processes of meat products cause degradation of the muscle membrane system and have a strong impact on the oxidation of intracellular fat, primarily phospholipids (**Marcinčák et al., 2010; Karakaya et al., 2011**). Thermal treatment makes oxidative processes faster, what significantly changes the value of thiobarbituric acid. The level of oxidative damage of lipids in the manufacture and storage of poultry sausages is presented in Table 3.

As regards determination of oxidative stability of raw-cooked meat products (stored at 4 °C) on day 1, the highest MDA content was found in control group (0.107 mg.kg<sup>-1</sup>) compared to experimental groups E1 and E2 (0.097 and 0.102 mg.kg<sup>-1</sup>, respectively). The highest oxidative stability for all the storage times was observed in

E1 group that coincides with the highest antioxidant activity (100.5 ±0.7%) of grape varieties extracts added in this group (Blauburger and Cabernet Sauvignon) compared to Dunaj GSE added in E2 group (55.8 ±0.8%). On day 12, the lowest MDA content was found in E1 group (0.192 mg.kg<sup>-1</sup>) compared to E2 and C groups (0.207 and 0.221 mg.kg<sup>-1</sup>, respectively). On the whole, addition of GSE all the grape varieties examined in the present study resulted in increasing the oxidative stability and thus extending the storage life of raw-cooked meat products, which is consistent with the findings of **Mielnik et al. (2006)**, **Özvural and Vural (2010)**, **Özvural and Vural (2013)**, and **Ryu et al. (2014)**.

The mean scores of sensory characteristics of raw-cooked meat products (surface appearance and colour, appearance and colour in cross-section, texture, aroma, and taste) after addition of GSE are presented in Table 4. The highest mean scores for each sensory characteristic was found in control group, however, no significant differences ( $p > 0.05$ ) among the groups were detected. The results demonstrated that GSE of grape varieties investigated in the present study had no significant effect ( $p > 0.05$ ) on sensory characteristics of raw-cooked meat products since the panelists did not perceive differences among the samples. Moreover, the samples from experimental groups were shown to be less acceptable in appearance and colour in cross-section and texture than that from control group. Similar results were found in study of **Brannan (2009)** who investigated grape seed in ground chicken, as well as **Kulkarni et al. (2011)** who investigated grape seed in beef sausages, with no significant effects on sensory quality.

**Table 2** Antioxidant activity (AA) of grape seed extracts of different grape varieties (%). Values are given as mean ±SD.

Grape variety	AA
Blauburger and Cabernet Sauvignon	100.5 ±0.7
Dunaj	55.8 ±0.8

Note: mean – average; SD – standard deviation.

**Table 3** Values of thiobarbituric number during the storage expressed as MDA (mg.kg<sup>-1</sup>). Values are given as mean ±SD.

Storage time	Group			p-value
	C	E1	E2	
Day 1	0.107 ±0.007	0.097 ±0.006	0.102 ±0.005	0.086
Day 4	0.122 ±0.013	0.107 ±0.011	0.116 ±0.008	0.185
Day 8	0.179 ±0.011	0.158 ±0.019	0.170 ±0.005	0.139
Day 12	0.221 ±0.015 <sup>a</sup>	0.192 ±0.010 <sup>b</sup>	0.207 ±0.014 <sup>ab</sup>	0.028

Note: MDA – malondialdehyde; C – control group; E1, E2 – experimental groups; a, b – means within a row with different superscripts differ significantly at  $p \leq 0.05$ ; mean – average; SD – standard deviation.

**Table 4** Sensory evaluation of raw-cooked meat products. Values are given as mean ±SD.

Sensory characteristic	Group			p-value
	C	E1	E2	
Surface appearance and colour	5.40 ±0.490	5.20 ±0.510	5.40 ±0.800	0.587
Appearance and colour in cross-section	5.60 ±0.374	5.40 ±0.374	5.40 ±0.374	0.471
Texture	5.80 ±0.400	5.50 ±0.775	5.50 ±0.447	0.347
Aroma	5.70 ±0.400	5.50 ±0.447	5.60 ±0.490	0.524
Taste	5.50 ±0.447	5.40 ±0.374	5.50 ±0.447	0.740

Note: C – control group; E1, E2 – experimental groups.

## CONCLUSION

It can be concluded that the sensory quality was not significantly ( $p > 0.05$ ) affected by application of extracts from grape seeds (Blauburger + Cabernet Sauvignon and Danube) in amount 10 ml.kg<sup>-1</sup> of produced spiske sausages. Oxidation stability of Spiš frankfurters after 12 days of storage at 4 °C was positively influenced ( $p \leq 0.05$ ) only in the group with addition of extract made from grape seed Blauburger + Cabernet Sauvignon. This may probably related with the higher antioxidant activity of extract of this variety (100.5%) compared to an extract made from grape seed variety of Danube (55.8%).

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