THE EFFECTS OF GRAPE SEED FLOUR ON THE RAW AND COOKED BEEF PATTIES QUALITY

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Abstract. The effects of grape seed flour (GSF; 0, 0.5, 1, 2%) on the physical, chemical, and sensory properties of beef patties were investigated. Meat patties were prepared using beef, beef fat, and spices. Raw beef patties were cooked for 20 min. in a preheated oven at 180ºC. Effects of the GSF on pH, proximate composition and instrumental colour values of raw and cooked beef patties were determined. Moreover, cooking yield, dimension reduction, and sensory properties of beef patties were studied. The effects of GSF on the moisture, dimension reduction, and instrumental colour values of beef patties were found to be significant ($p<0.01$). Increasing amounts of GSF in the beef patties decreased L and b values. Moreover, GSF decreased dimension reduction values of beef patties. This effect on the dimension reduction values was found to be important by the addition of 1% of grape seed flour. While GSF with the addition up to 1% did not cause significant differences on the moisture values of cooked beef patties, the addition of 2% GSF decreased moisture values. The addition of GSF did not cause a significant difference on sensory properties of beef patties.

Keywords: beef, grape seed, meat patties, raw patties, cooked patties

Introduction. The type of non-meat ingredients in formulations of meat products are the most important factors for product quality, technological properties and health (Bañón et al., 2007; Özvural & Vural, 2011; Kulkarni *et al.*, 2011; Kurt & Kılınççeker, 2012). Formulations of meat patties may include one or more non-meat ingredients (Kurt & Kılınççeker, 2012). Some of them are cereal, vegetable and fruit products. Grape seed extract is used in ground meat products as a source of antioxidant. It decreases fat oxidation in fatty foods. However, grape seed flour can affect physical, technological, and sensory properties of the meat products (Özvural & Vural, 2011).

Grape seed contains significant levels of minerals and vitamins. In particular, it is an important source of calcium, potassium, sodium, and iron. Moreover, it is an important source of A, B1, B2, C vitamins and niacin (Shi *et al.*, 2003; Konar, 2010). Grape seed, in general, contains 40–70% fibre, 16% oil, 11% protein and 7% phenolic compounds (Konar, 2010). Fiber, fat, and proteins can affect physical, technological and sensory properties of the meat products. However, phenolic compounds affect oxidative stability of meat products as an important source of antioxidants. The effects of antioxidants in grapes may protect against cardiovascular disease and cancer (Yılmaz & Toledo, 2004; Lutterodt *et al.*, 2011).

Grape seed and the grape skin can be used as functional additives in different foods (Shrikhande, 2000). Grape seed flour can improve technological properties of meat products (Kyialbek, 2008). However, the level of use of grape seed products can be limited by its effects on sensory properties of meat products (Özvural & Vural, 2011). Therefore, it is important to determine usage level of grape seed flour in meat products.

Grape seed extract has been studied in many food products to determine its antioxidant effect. However, grape seed flour's influence on meat products has been studied so far by only a very few researchers, so there is very little information available. The objective of this study was to determine the effects of grape seed flour on the physical, chemical, and sensory properties of beef patties.

Materials and Methods

The day after slaughter, three-year-olds beef (*M. semimembranosus*) and beef fat were obtained from a local meat processor (Adıyaman, Turkey). Black grape seed flour (fibre 71%, protein 9%, oil 14%, moisture 4% and ash 2%) was obtained from Öktaş Gıda Ltd. Şti. (Denizli, Turkey).

Patty preparation. Beef and beef fat pieces (2–3 cm^3 in size) were mixed and twice minced in a grinder (Tefal, Le Hachoir 1500, France). This minced meat and fat mixture was divided into 4 parts. Each of them was used for each separate formulation (Table 1). One kg of each formulation was then kneaded for 6 min by hand to obtain uniform patty batter. Next, each 25 g of batter was shaped with silicone moulds into 1.4 cm thick and 4.8 cm in diameter circular-shaped patties. The patties were cooked in a hot air oven (Memmert Ecocell, München, Germany) at 180ºC for 20 min. The core temperature of patties was reached to 75°C during cooking. Core temperature was measured by a digital thermometer with a penetration probe (Testo 926, Lenzkirch, Germany). Four meat patties were used for the analysis of each treatment.

Determination of the pH and composition. Ten grams of sample was homogenized in 100 ml distilled water and the pH was measured using a pH meter (Orion 3-star, MA, USA) equipped with temperature probe as outlined by Ockerman (1985). Moisture, fat, protein and ash were determined according to AOAC (2000). Protein was determined as crude protein using the Kjeldahl method. Fat was determined as crude fat using the Soxhelet extraction.

Table 1. **Formulations of beef patties**

Materials	1. Formulation (%)	2. Formulation (%)	3. Formulation (%)	4. Formulation (%)
Minced meat	93.5	93	92.5	91.5
GSF	0.0	0.5	1.0	2.0
Salt	1.5	1.5	1.5	1.5
Onion powder	1.7	1.7	1.7	1.7
Red pepper	1.2	1.2	1.2	1.2
Cumin	0.3	0.3	0.3	0.3
Black pepper	0.3	0.3	0.3	0.3
Bread crumbs	1.5	1.5	1.5	1.5
GSF: Grape seed flour				

Table 2. **Proximate composition and pH values of raw beef patties**

GSF (%)	pH	Moisture (%)	Fat (%)	Protein (%)	Ash (%)
0.0	6.51±0.04	62.93±0.09 ^{c}	13.19±0.04	18.26±0.25	1.48±0.03
0.5	6.46±0.02	62.72±0.11 ^{bc}	13.01±0.12	18.27±0.05	1.55±0.06
1.0	6.46±0.01	62.12±0.12 ^{ab}	13.07±0.05	18.62±0.33	1.58±0.01
2.0	6.41±0.05	61.55±0.42 ^{a}	13.08±0.11	18.17±0.28	1.64±0.03
SL	NS	S	NS	NS	NS
SL: significance level, NS: non-significance, S: significance. $^{a-c}$ Different superscripts in the same column indicate significant differences ($p<0.05$). Values are means ± SD. GSF: Grape seed flour					

Table 3. **The composition and pH values of cooked beef patties**

GSF (%)	pH	Moisture (%)	Fat (%)	Protein (%)	Ash (%)
0.0	6.58±0.05	57.58±0.26 ^{b}	15.25±0.18	21.00±0.20	2.01±0.16
0.5	6.56±0.07	57.81±0.30 ^{b}	14.74±0.50	20.90±0.10	2.10±0.18
1.0	6.59±0.05	57.30±0.10 ^{b}	14.74±0.16	20.77±0.18	2.14±0.12
2.0	6.56±0.03	56.50±0.02 ^{a}	14.80±0.20	20.66±0.04	2.21±0.10
SL	NS	S	NS	NS	NS
SL: significance level, NS: non-significance, S: significance, $^{a-b}$ Different superscripts in the same column indicate significant differences ($p<0.05$). Values are means ± SD. GSF: Grape seed flour					

Determination of the cooking yield. Cooking yield was determined as follows:

$$Cooking\ Yield\ (\%) = \frac{w_1 \times 100}{w_0}$$

where w_0 is the weight of patties before cooking and w_1 is the weight after cooking.

Determination of the diameter reduction. Diameter reduction was calculated as follows:

$$Diameter\ Reduction\ (\%) = \frac{(d_0 - d_1) \times 100}{d_0}$$

where d_0 is the diameter of patties before cooking and d_1 is the diameter after cooking.

Instrumental colour analysis. The colour values of the raw and cooked beef patties were measured by using a portable colorimeter (Minolta CR-400, Osaka, Japan). The instrument was standardised against a white standardisation plate before each measurement. The colour was measured according to CIELAB systems as L (lightness), a (redness) and b (yellowness) values, as described by Dogan (2006). Six beef patties were used for the analysis of each treatment.

Sensory analysis. The cooked beef patties were cooled to room temperature and coded with geometric shapes. They were served in a random order. Water and bread were served after each sample to remove traces of the previous sample from mouth. Ten trained panel members who were selected and trained according to Yetim & Kesmen (2009) assessed the sensory properties using a hedonic scale for the appearance, color, brittleness, odour, flavour, and overall acceptability. The scale consisted of scores from 1 to 9. The values in the scale indicated the following range of reactions: 1: dislike extremely to 9: like extremely.

Statistical analysis. The data were subjected to analysis of variance (ANOVA), and the results were expressed as mean ± standard deviation (SD). When there were differences among the samples, the differences were compared by Duncan's multiple-range test using a software (SPSS, Chicago, IL, USA).

Results

The composition and pH values of raw and cooked meat patties. The effects of GSF on the moisture values of raw and cooked beef patties were found to be significant ($p<0.01$, Table 2). However, the effects of GSF on the pH, fat, protein and ash values of raw and

cooked beef patties were not found to be significant (P>0.05, Table 2 and 3).

The addition of GSF decreased moisture values of raw and cooked beef patties.

Table 4. **The effects of GSF on the technological properties of cooked beef patties**

GSF (%)	Dimension Reduction (%)	Cooking Yield (%)
0.0	12.27±0.04 [b]	87.80±0.43
0.5	12.24±0.04 [b]	88.19±0.70
1.0	11.03±0.40 [a]	88.60±0.37
2.0	11.75±0.04 [b]	88.34±0.33
SL	S	NS
SL: significance level, NS: non-significance, S: significance. [a-b] Different superscripts in the same column indicate significant differences (p<0.05). Values are means ± SD. GSF: Grape seed flour		

Table 5. **The effects of GSF on the L, a and b values of raw beef patties**

GSF (%)	L	a	b
0.0	31.94±0.25 [c]	16.33±0.26 [d]	11.10±0.51 [c]
0.5	31.01±0.21 [b]	14.73±0.26 [c]	10.29±0.11 [b]
1.0	30.47±0.48 [b]	12.97±0.03 [b]	9.73±0.04 [b]
2.0	29.02±0.08 [a]	11.48±0.28 [a]	8.54±0.27 [a]
SL	S	S	S
SL: significance level, NS: non-significance, S: significance. [a-c] Different superscripts in the same column indicate significant differences (p<0.05). Values are means ± SD. GSF: Grape seed flour			

Table 6. **The effects of GSF on the L, a and b values of cooked beef patties**

GSF (%)	L	a	b
0.0	28.27±0.53 [c]	7.32±0.47 [c]	6.83±0.03 [c]
0.5	26.78±1.10 [ab]	6.42±0.34 [b]	5.41±0.40 [b]
1.0	26.21±0.40 [a]	5.60±0.26 [ab]	4.69±0.50 [ab]
2.0	25.43±0.17 [a]	5.15±0.08 [a]	4.27±0.04 [a]
SL	S	S	S
SL: significance level, NS: non-significance, S: significance. [a-c] Different superscripts in the same column indicate significant differences (p<0.05). Values are means ± SD. GSF: Grape seed flour			

The shape and cooking yield of cooked beef patties. GSF on the shape of beef patties resulted in a significant (p<0.01) difference. As can be seen in Table 4, the addition of GSF decreased diameter reduction. However, the effect of 1% GSF on the diameter reduction values of beef patties was found to be significant. Although GSF increased cooking yield of beef patties, this increase was not found to be statistically significant as shown in Table 4.

The instrumental evaluation of colour of raw and cooked beef patties. The effects of GSF on the colour of raw and cooked beef patties were found to be significant (P<0.01). As can be seen in Tables 5 and 6, colour values of raw and cooked beef patties decreased with the addition of GSF.

Sensory properties of beef patties. Although the addition of GSF at the 2% level decreased colour, odour, and general acceptance scores, the effects of GSF on the sensory properties was not causing a statistically significant difference (Table 7).

Table 7. **The effects of GSF on the sensory properties of beef patties**

GSF (%)	General appearance	Colour	Odour	Texture	Flavour	General acceptance
0.0	7.20±0.42	7.30±0.14	6.70±0.14	6.60±0.28	6.55±0.35	6.75±0.21
0.5	7.40±0.57	7.00±0.42	6.65±0.35	6.15±0.21	6.60±0.28	6.75±0.21
1.0	7.25±0.64	6.65±0.50	6.80±0.14	6.50±0.14	6.45±0.35	6.45±0.21
2.0	7.50±0.28	6.45±0.21	6.30±0.14	6.70±0.28	6.10±0.42	6.40±0.42
SL	NS	NS	NS	NS	NS	NS
SL: significance level, NS: non-significance, S: significance. Values are means ± SD. GSF: Grape seed flour						

Discussion

As shown in Table 3, the addition of 2% GSF in the beef patties decreased the moisture content of cooked beef patties. This difference in the moisture values might be due to lower moisture content in GSF than in meat. However, the addition of GSF in the beef patties to the level of 1% did not cause a difference in the moisture content of cooked beef patties significantly (P> 0.05). When these levels (0%, 0.5 and 1) were considered to cause important differences in the moisture values of raw patties, the addition of GSF up to 1% might be reduce moisture loss during cooking. Özvural & Vural (2008) reported that grape seed flour decreased moisture values of sausage.

The decline in diameter values of cooked beef patties might be considered to be associated with the fibrous structure and reducing moisture loss of GSF. One of the changes in the physical properties of beef patties is dimension reduction during cooking. Kurt & Kılınççeker (2012) reported that the additives such as plant products affected dimensions of meat patties during cooking.

The differences in the colour values might be due to the colour pigments of GSF. Black grape seed flour colour was darker than the beef. It can be said that this difference was effective in reducing the colour values of beef patties. Özvural & Vural (2011) reported that grape seed, the by-product of the production of red wine, decreased colour values of sausage significantly.

The effects of heat treatment decreased colour values of beef patties as turned out by comparison of Tables 5 and 6 were compared. In particular, the decrease of **a** value was higher than that of **L** and **b** values. The effect of heat treatment on the colour values of beef patties might be related to denaturation of colour pigments of GSF and meat. Colour change of meat can be attributed to the globulin of myoglobin being denatured with heat treatment. Karabudak (2003) reported that the heating process denatured the heme pigment. Moreover, the colour values might be due to the decreasing moisture content (Tables 2, 3).

Although the addition of GSF decreased instrumental colour (L, a, b) values (Table 5) this difference was not found to be significant by the panellists (Table 7). They did not find a significant difference in the other sensory properties. The sensory scores of the parameters to be above 6, in terms of sensory quality properties of beef patties, grape seed flour with the addition of up to 2% could be possible.

Conclusion. Grape seed flour may have a potential application as an additive in meat products. The addition of GSF more than 1% decreased moisture values of beef patties. Moreover, colour values of beef patties decreased with the increasing addition of GSF. However, grape seed flour addition into the beef patties up to the level of 2% can be recommended.

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References

1. AOAC, 2000. Official methods of analysis of AOAC international (17.Edition). USA,

2. Bañón S., Díaz P., Rodríguez M., Garrido M.D., Price A. Ascorbate, green tea and grape seed extracts increase the shelf life of low sulphite beef patties. Meat Sci. 2007. 77. P. 626–633.

3. Dogan I.S. Factors affecting wafer sheet quality. Int. J. Food Sci. Tech. 2006. 41. P. 569–576.

4. Karabudak E. The effects of iron compounds in muscle foods on the lipid oxidation (in Turkish). Gıda. 2003. 28(2). P. 195–201.

5. Konar N., Grape seed (in Turkish). http://nevzatkonar.blogspot. com/2010/08/uzumcekirdegi.html. 2010.

6. Kulkarni S., DeSantos F.A., Kattamuri S., Rossi S.J., Brewer M.S. Effect of grape seed extract on oxidative, color and sensory stability of a pre-cooked, frozen, re-heated beef sausage model system. Meat Sci. 2011. 88. P. 139–144.

7. Kurt Ş., Kılınççeker O. The effects of cereal and legume flours on the quality characteristics of beef patties. Kafkas Univ. Vet. Fak. Derg. 2012. 18. P. 725–730.

8. Lutterodt, H., Slavin M., Whent M., Turner E., Yu L. Fatty acid composition, oxidative stability, antioxidant and antiproliferative properties of selected cold-pressed grape seed oils and flours. Food chem. 2011. 128. P. 391–399.

9. Ockerman H.W. pH measurement. In, Quality Control of Postmortem Muscle Tissue. Vol. 2, 2nd ed., The Ohio State University, Columbus, Ohio. 1985.

10. Özvural E.B., Vura, H., Grape seed flour is a viable ingredient to improve the nutritional profile and reduce lipid oxidation of frankfurters. Meat science. 2011. 88. P. 179–183.

11. Shi J., Yu J., Pohorly J.E., Kakuda Y. Polyphenolics in grape seeds biochemistry and functionality. J. Medicinal Food. 2003. 6. P. 291–299.

12. Shrikhande A.J. Wine by-products with health benefits. Food Res. Int. 2000. 33. P 469–474.

13. Yetim H., Kesmen Z. Food analysis; The sensory analysis of foods (2.Ed., in Turkish). University of Erciyes, Publication No: 163, Kayseri-Turkey. 2009.

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