



Effect of grape seed extract on the quality of local meat product (basturma) during storage

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Abstract

Basturma is an Iraqi meat product produced to preserve meat in Iraq and manufactured from beef, fat, salt, and other spices. The goal of this research was to evaluate the impact of adding grape seed flour (GSF) in several doses (0, 1, 2, and 4%) on the local Iraqi meat product (basturma) stored at room temperature for 14 days. The proximate composition (moisture, crude fat, and crude protein) and microbiological properties (total plate count and coliform count) were investigated. In general, the applications of different concentrations of GSF showed significant differences in the moisture values throughout the storage period, and higher significant differences in the total bacteria count and coliform count have been noticed in all the treatments compared with the control treatment from the first day till the end of storage period. This study has demonstrated that GSF has the capability to be applied as a food ingredient in basturma.

Keywords: grape seed; basturma; food preservative; food microbiology.

Practical Application: Improving the shelf life, chemical composition and sensory quality of Basturma by the addition of GSF.

1 INTRODUCTION

Basturma is a traditional Iraqi delicacy, produced mostly in the region of Nineveh but is also available in other regions around the country. It resembles the Turkish sausage “Sucuk,” which is a dry fermented sausage produced in Turkey (Gonulalan et al., 2004).

Basturma is fermented under climatic conditions. Bozkurt and Erkmén (2002) reported that, during the manufacturing of Turkish Sucuk, the fermentation process was triggered by inoculation from either the raw ingredient or the surroundings. The ripening of basturma through storage period represents a couple of reactions, including those involving proteins, lipids, and carbohydrates, and different kinds of end products are produced, which indicates that there are many sources of contamination in basturma.

Meat plays a vital role in the development of pathogens. Dorsa et al. (1998) discovered that the microbiological status of the ground beef component used for grinding was the most crucial factor in determining the source and quantity of bacterial infection in minced meat. In addition, moisture was considered one of the important elements that determine the quality of the meat, and its percentage in meat is about 70% (Al-Marazany, 2008). Moisture affects the quality of meat during storage and production; hence, drying food or reducing the content of moisture is considered one of the traditional ways of food preservation thousands of years ago.

Red meat is regarded as a major source of protein and provides consumers with a large percentage of their daily needs of protein. Also, fat is considered an important component in

meat because it provides energy, essential fatty acids, and soluble vitamins in fat (Crehan et al., 2000).

Basturma in Iraq is manufactured from beef, fat, spices, garlic, and salt. Non-meat components utilized in the preparation of beef products are critical elements in the product's quality (Kulkarni et al., 2011). These non-meat components are applied to enhance chemical and microbiological properties. Grape seed flour (GSF) is one of these components that can be utilized as a food supplement (Shrikhande, 2000).

GSF contains a significant amount of vitamins, minerals, and phenolic ingredients (Shi et al., 2003), and GSF consists of 11% protein, 16% oil, and 7% phenolic components as reported by Campos et al. (2008). Although the nutritional contents of grape seed can influence meat composition, the sensory qualities of beef limit the dose amount (Özvural & Vural, 2011). Also, Anastasiadi et al. (2009) showed that GSF contains flavonoids that play a major role in its antimicrobial activity.

Hence, this study was carried out to investigate the influence of adding 0, 1, 2, and 4% grape seed powder on the chemical and microbiological characteristics of basturma during storage at room temperature for 14 days.

2 MATERIALS AND METHODS

2.1 Collection and preparation of materials

Meat specimens (beef meat) were collected from the local market in Mosul city, transported to the laboratory under proper hygiene settings, and stored in the refrigerator. The black

Received: 14 Jan., 2023

Accepted: 28 May, 2023

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grape seeds were obtained from the Nineveh Governorate's local markets (Iraq). The grape seeds were carefully separated from the skin, washed, dried, crushed using a laboratory mill (hammer-type mill), passed through a sieve until fine flour was formed, and then sealed in polyethylene bags at -20°C until use. Table 1 lists the protein, carbohydrate, fat/lipid, fiber, ash, moisture, and polyphenol contents of GSF.

2.2 Preparation of samples

The production of basturma was prepared using the traditional method. Beef meat was cut into pieces after the addition of fat. Then, it was mixed by hand after adding salt, garlic, different spices, and GSF. The mixture was split for four different treatments. Later, the samples were stuffed in animal casings (intestine locally known as "Sundaweel") and stored under room temperature for 14 days. The contents of treatments are as follows:

- Treatment 1: 80% beef meat + 12% beef fat + 0% GSF + 2% salt + 2.5% garlic + 3.5 spices;
- Treatment 2: 79% beef meat + 12% beef fat + 1% GSF + 2% salt + 2.5% garlic + 3.5 spices;
- Treatment 3: 77% beef meat + 12% beef fat + 3% GSF + 2% salt + 2.5% garlic + 3.5 spices;
- Treatment 4: 76% beef meat + 12% beef fat + 4% GSF + 2% salt + 2.5% garlic + 3.5 spices.

2.3 Chemical analytics

- Determination of the moisture content: The percentage of moisture was estimated based on the method mentioned in AOAC (2019);
- Determination of the protein: The estimation of total nitrogen based on the method mentioned in AOAC (2019) and by applying the Kjeldahl conversion factor of 6.25;
- Estimation of the fat: The percentage of fat was estimated based on the method mentioned in AOAC (2019) and by using Soxhlet extraction units.

Table 1. Chemical composition of black GSF.

No.	Chemical products	Value
1	Moisture (%)	7.58±0.94
2	Proteins (%)	12.41±0.46
3	Carbohydrate (%)	21.21±0.12
4	Ash (%)	2.72±0.87
5	Fiber (%)	41.61±0.26
6	Fat (%)	14.23±0.86
7	Total flavonoids (mg/g dry weight)	18.22±0.83
8	Total phenolics (mg/g dry weight)	65.35±1.22
9	Anthocyanins (µg/g dry weight)	1.17±0.11
10	Tannins (mg/g dry weight)	1.83±0.24

2.4 Microbiological analysis

The total bacterial count was determined using AOAC (2019), and the *Escherichia coli* count was determined using the method suggested by Shabbaziet al. (2016).

2.5 Sensory analysis

Sensory assessments were conducted with eight trained testers. The assessors presumed the basic odor and color vision tests. The presented samples weighed 40 g of basturma and were served to assessors in dishes at room temperature. The meat's color, odor, and overall acceptability were assessed. Before each assessment, each evaluator drank a glass of water and randomly tested the samples. Every factor was graded on a five scale, with 1 being the lowest and 5 being the highest (Qaziyani et al., 2019).

2.6 Statistical analysis

The complete randomized design (CRD) was used to evaluate the data, and the findings were presented as mean/standard deviation (SD). To detect differences among treatment at the level of $P < 0.05$, Duncan multiple range test was used.

3 RESULTS

3.1 Basturma composition and pH values

The findings show that the effects of adding GSF on the pH levels were not significant ($p < 0.05$), as shown in Table 2. Furthermore, the pH levels were affected by the storage period, and the effect was significant ($p < 0.05$). The highest pH value was 5.91 in the control on the 1st day, and the lowest value was 4.83 in the treated sample with 4% GSF on the 14th day.

Table 3 shows that the impacts of GSF on the moisture content were significant at $p < 0.05$ levels. On the 7th day of storage, GSF inclusion reduced the moisture content of the basturma, which was highest in the control treatment (56.63) and reached 51.45 in the treated sample with the addition of 4% of GSF. Although the addition of GSF reduced the moisture level of the basturma on the 1st and 14th days, these reductions were not significant. Furthermore, the impacts of storage period on the moisture levels were significant.

The addition of GSF had no influence on the fat and protein levels of basturma, as shown in Tables 4 and 5. The effect of storage period on the protein and fat levels was significant at $p < 0.05$ levels. The lowest value for fat was 12.36 in the control

Table 2. Impacts of GSF on the pH value of basturma during storage*.

Grape Seed Flour (%)	1st day	7th day	14th day
0	5.91±0.02 ^A	5.07±0.13 ^B	4.72±0.02 ^C
1	5.82±0.13 ^A	5.06±0.05 ^B	4.78±0.06 ^C
2	5.72±0.04 ^A	5.03±0.07 ^B	4.81±0.04 ^C
4	5.68±0.05 ^A	5.05±0.03 ^B	4.75±0.06 ^C

*Different letters denote significant differences ($p < 0.05$).

treatment on the 1st day and it reached 19.96 in the treated sample with the addition of 4% of GSF on the 14th day. The lowest value for protein was 23.56 in the control treatment on the 1st day, and it reached 28.95 in the treated sample with the addition of 4% of GSF on the 14th day.

3.2 Basturma microbiological quality

Table 6 shows the results of using different concentrations of GSF on the total bacterial count during storage of basturma. Significant changes ($P < 0.05$) were observed in different treatments during storage period. The higher amount was 385×10^6 CFU/g

Table 3. Impacts of GSF on the moisture content of basturma during storage*.

Grape Seed Flour (%)	1st day	7th day	14th day
0	63.48±2.25 ^A	56.63±0.48 ^{a,B}	44.85±1.53 ^C
1	62.31±1.81 ^A	52.49±0.74 ^{b,B}	43.74±2.28 ^C
2	63.38±0.32 ^A	51.67±0.22 ^{b,B}	43.67±0.47 ^C
4	62.20±0.06 ^A	51.54±0.69 ^{b,B}	43.52±2.93 ^C

*Different lowercase letters denote significant differences ($p < 0.05$). Different capital letters denote significant differences ($p < 0.05$).

Table 4. Impacts of GSF on the fat value of basturma during storage*.

Grape Seed Flour (%)	1st day	7th day	14th day
0	12.36±2.84 ^C	15.80±0.84 ^B	19.90±1.09 ^A
1	12.60±2.45 ^C	17.25±0.25 ^B	19.83±0.95 ^A
2	12.59±0.11 ^C	17.34±0.69 ^B	19.75±1.10 ^A
4	12.83±0.04 ^C	16.84±0.81 ^B	19.96±2.63 ^A

*Different letters denote significant differences ($p < 0.05$).

Table 5. Impacts of GSF on the protein value of basturma during storage*.

Grape Seed Flour (%)	1st day	7th day	14th day
0	23.56±0.13 ^C	26.01±0.42 ^B	28.48±0.06 ^A
1	23.67±0.27 ^C	25.89±0.16 ^B	28.72±0.02 ^A
2	23.78±0.10 ^C	26.16±0.44 ^B	28.86±1.59 ^A
4	23.85±0.02 ^C	26.08±0.69 ^B	28.95±0.33 ^A

*Different letters denote significant differences ($p < 0.05$).

Table 6. Effects of GSF and storage period on total bacterial count (1×10^6 CFU*/g)*.

Grape Seed Flour (%)	1st day	7th day	14th day
0	385±30.05 ^{a,A}	290±21.73 ^{b,B}	258±50.40 ^{b,C}
1	356±33.00 ^{a,A}	284±33.97 ^{b,B}	253±36.35 ^{b,C}
2	265±24.42 ^{b,C}	171±15.01 ^{d,E}	145±19.28 ^{e,F}
4	198±30.19 ^{c,D}	170±24.68 ^{d,E}	140±38.76 ^{e,F}

*Different lowercase letters denote significant differences ($p < 0.05$). Different capital letters denote significant differences ($p < 0.05$).

on the 1st day of the control treatment, which then decreased to 258×10^6 CFU/g on the 14th day. The content in control was the highest in comparison with other treatments.

There was a decrease in total counts when GSF was used, and this decrease was significant at $P < 0.05$ levels in most of the treatments through the storage period. The effect of adding 4% concentration of GSF was found to be more effective than other doses. On the 1st day, significant decrease was found when 4% concentration was used, and the total bacterial count reached 198×10^6 CFU/g.

The effects of the additive used in this study on coliform bacteria are summarized in Table 7. The storage period had significantly ($P < 0.05$) decreased on control and all the treatments. The highest count was noticed in control. The counts of coliform were 398×10^6 CFU/g on the 1st day, which then significantly decreased to 276×10^6 and 268×10^6 CFU/g on the 7th and 14th days, respectively.

The results showed that the use of GSF significantly ($P < 0.05$) reduced coliform bacteria compared to the control during the storage period. The effect of adding 4% concentration of GSF was found to be more effective than other doses. On the 1st day, significant decrease was found when 4% concentration was used, and the coliform count reached 190×10^6 CFU/g.

4 DISCUSSION

The addition of GSF had no effect on the pH levels, as shown in Table 1, but the storage period significantly reduced the pH levels. This might be due to the lactic acid bacteria in fresh meat releasing lactic acid, which lowers the pH levels of the basturma, as suggested by Bover-Cid et al. (2001).

Table 3 shows that the impacts of GSF on the moisture levels were significant on the 7th day but not on the 1st or 14th day. Kurt (2016) obtained similar results by applying grape seed to Turkish sucuk. Furthermore, the impacts of storage period on the moisture levels were determined to be significant. This is mainly due to the delay in the basturma production season and the gradual rise in temperatures. These results are in agreement with those suggested by Al-Marazany (2008) as they reported a loss in the moisture value of basturma during storage.

Tables 4 and 5 show that the addition of GSF had no influence on the fat and protein values of basturma. The effect of storage period on the solid content was found to be significant.

Table 7. Effect of GSF and storage period on coliform count (1×10^6 CFU*/g)*.

Grape Seed Flour (%)	1st day	7th day	14th day
0	398±47.74 ^{a,A}	276±21.38 ^{b,B}	268±38.55 ^{b,B}
1	357±33.17 ^{a,A}	269±33.97 ^{b,B}	257±36.35 ^{b,B}
2	250±28.74 ^{b,B}	245±9.644 ^{b,B}	239±30.41 ^{b,B}
4	190±21.22 ^{c,C}	169±18.50 ^{d,D}	129±36.46 ^{e,E}

*Different lowercase letters denote significant differences ($p < 0.05$). Different capital letters denote significant differences ($p < 0.05$).

This is due to the decrease in moisture content, which causes an increase in the percentages of protein and fat. These results are in agreement with those suggested by Zanardi et al. (2002) as they noticed a reduction in the moisture content of the sausage produced after 40 days of storage, which led to an increase in the solid contents.

4.1 *Basturma* microbiological quality

Some bacteria were studied in *basturma* products throughout the storage period under room temperature. The total count (Table 6) and coliform count (Table 7) were investigated.

Our study revealed that the effect of storage period on the total bacterial count was significant ($P < 0.05$) across all the treatments. This reduction might be due to the conditions of packaging and storage. Furthermore, there was a significant decrease ($P < 0.05$) in total counts when GSF was used in most of the treatments. The addition of 4% GSF, in particular, was more effective than other doses. In general, it was noticed that using GSF significantly decreased the total count in comparison with control from the 1st day. This effect could be attributed to GSF's flavonoid content. According to Anastasiadi et al. (2009), flavonoids and flavonoid derivatives in grape seed play a crucial role in its antibacterial properties.

Our result revealed that coliform bacteria had been affected by the addition of GSF and the storage period, and it was significant ($P < 0.05$). Coliform bacteria were reduced compared to the control in all the storage periods. This might be attributed to the proanthocyanidin content of the grape seeds, which has potential antimicrobial activities in preventing contamination of food by pathogens, as reported by Abdelhakam et al. (2019), Perumalla and Hettiarachchy (2011), and Xia et al. (2010).

4.2 Sensory evaluation

The impacts of GSF on the sensory parameters were significant ($p < 0.05$) in all scores except for the brittleness scores, as shown in Figure 1. The effect of GSF caused a significant difference in the color parameters, especially after the addition of 2 and 4% of GSF, which caused the lowest score in color in comparison with the control and other treatment. The findings are similar to those reported by Payandan et al. (2017).

A significant difference ($P > 0.05$) was not found in the odor score of meat among samples having different dosages of GSF. However, compared to the control treatment, a significant difference ($P < 0.05$) was found, and the lowest score (3.97) was found in the control treatment. The presence of off-odor could be attributed to protein degradation during storage. The addition of GSF slowed down this behavior. The findings are comparable to those reported by Payandan et al. (2017) and Suarez M. et al. (2014).

As a result, no significant differences ($P > 0.05$) were noticed at the doses of 0, 1, and 2% of GSF. The fall in overall acceptance at 4% concentration could be attributed to the decrease in the color score.

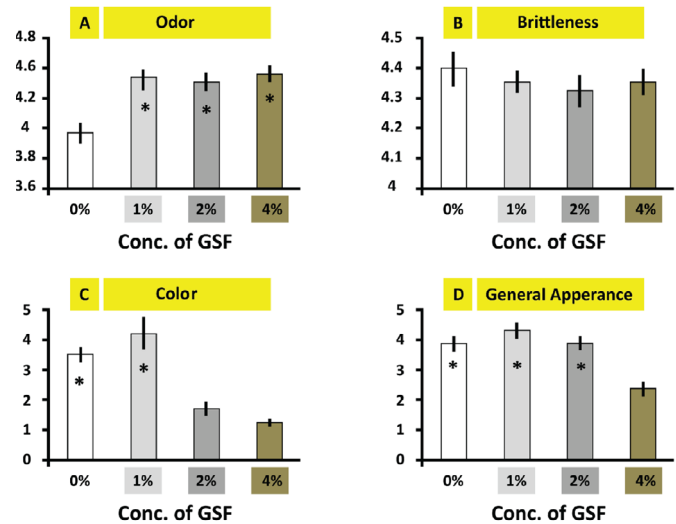


Figure 1. Improved sensory parameters in the presence of grape seed flour with inverse relationship to concentration (0, 1, 2, and 4%). Data are expressed as mean \pm SD. Asterisks denote < 0.05 statistically significant difference expect (B): (A) as compared to 0%; (C) as compared to 2%; (D) as compared to 4%.

5 CONCLUSION

The study revealed that grape seed powder improves the preservation against infectious pathogens from contaminating the meat, and the chemical properties of beef meat with high nutritional values like protein. The use of grape seed powder could be suggested as a preservative, replacing the chemical preservatives (e.g., methylparaben, propylparaben, sodium benzoate, and benzoic acid) that are in current use.

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