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The Effect of Dried Peach Leaves Powders with Different Methods on Lipid Oxidation, Textural and Sensory Properties of Patties

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ABSTRACT

The aim of this study was to determine the effects of the dried peach leaves powders with different methods on pH and Thiobarbituric acid reactive substances (TBARS) values, cooking, textural and sensory properties of beef patties. Samples were divided into six treatment groups; control (without peach leaf powder/ Butylhydroxytoluene (BHT)), patties with BHT (0.01%), patties containing peach leaf powders (PLP) dried in air (AP) (%1) and in microwave oven (MwP) in three different concentrations (0.5%, 1%, 2%). Sample were stored at +4 ºC for 7 days. The pH of raw beef patties containing various levels of PLPs decreased slightly ($P<0.01$). The MwP addition significantly decreased ($P<0.01$) the TBARS value compared to the without peach leaf powder. At the end of the storage period, the TBARS value of the control group was 4.14 mg MDA/kg, while the TBARS value of MwP3 was 0.67 mg MDA/kg.

1. Introduction

Meat products can be spoiled in two different ways with chemical and microbiological deterioration. The most common chemical degradation in meat products is oxidative rancidity (Kanner 1994). The occurrence of oxidation in meat fat causes quality to deteriorate in meat products, resulting in reduced shelf life and changing in meat quality properties (Fernandez et al. 1997). Owing to their high contents of protein, fat and free water and large surface area (Tamkutė et al. 2021), beef patties are prone to oxidative deterioration.

Using antioxidants in meat and meat products have inhibited or reduced the lipid oxidation. There are many compounds with antioxidant effects, but only a few can be used in food products. The antioxidants may be of synthetic origin and /or of natural origin (Powell et al. 1986). However, since synthetic antioxidants cause toxic effects, the idea of natural antioxidants has increased (Shah et al. 2014). For this reason, studies related to identifying new antioxidants from plant sources because of the high content of phenolic compounds is carried out and provide alternative to currently used conventional antioxidants (Karre et al. 2013). Natural sources of antioxidants may be classified as plant and spice-derived antioxidants, fruit and vegetable-derived antioxidants, and others (Rather et al. 2016).

Peach (*Prunus persica* L.) is a garden plant belonging to the family Rosaceae, grown for its fruits (Gur 2011). Besides the nutritional and pharmacological value of peach fruits, peach leaf is traditionally used as sedative and laxative. It is also reported that peach leaves contain some phenolic compounds such as flavonols, hydroxycinnamates, caffeic acid, quercetin, isoquercetin, cynic acid, tannin, kaempferol, pruzic acid and ursolic acid (Upyr & Komissarenko 2002, Mokrani et al. 2019). Peach leaves have also antibacterial effect against to many pathogens, such as *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Listeria monocytogenes*. (Özpınar et al. 2013).

Drying is one of the most important technique and different drying methods such as freeze, microwave, vacuum has been commonly practiced in food technology. Nowadays, hybrid drying techniques have been used to combined with different non thermal methods, air drying method is still preferred due to its low cost and wide applicability (Srikanth et al. 2018).

However, microwave drying can be an advantageous method for food technology. This method promotes short drying time and enhances quality (Carvalho et al. 2021). This study was aimed to determine the influence of beef patties with peach leaf powders dried in air (AP) (%1) in microwave oven (MwP) on the lipid oxidation, color stability, cooking and sensory properties.

2. Materials and Methods

Materials

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Peach leaves (*Prunus persica L.*) were taken from a farmer (Konya, Turkey). The leaves were washed with distilled water and dried with two drying methods. In air drying procedure, the peach leaves were dried on filter papers at 23 °C approximately 7 days. Natural current of air was used for drying the leaves (Mbah et al, 2012). Second method was microwave process which were carried out in 650 W output power and 210-270 s power density (Alibaş 2012; Yaldız Cabi and Sarıçoban, 2019). To make powder, dried peach leaves were separately passed through a blender (Waring Commercial Blendor®, USA) for 45 s. Then, all peach leaf powders were placed in separate opaque glass containers and stored at +4 °C until use.

Preparation of patty

Fresh beef was obtained from a local market at 48 h post-mortem. All subcutaneous and connective tissue were removed from the meat. The meat and fat were minced through a 3 mm plate grinder and mixed with salt 1%). Peach leaf powders (PLPs) dried in microwave oven were added at 0%, 0.5%, 1%, 2% (Control, MwP1, MwP2, MwP3, respectively) and ground peach leaves dried in air (AP) at 1%. As the positive control group, the synthetic antioxidant Butylhydroxytoluene (BHT) was used at a rate of 0.01%. All ingredients were mixed as seperataly, shaped into approximately 4 cm diameters and 1.5 cm thick with a weight of 17–18 g. The patties were placed on plastic container and stored at 4±0.5 °C. The analyses were carried out on 1., 3., 5. and 7. days of storage. Sensory and , texture analysis and cooking properties were performed on the 3rd day.

pH value

pH values were measured by a pH meter (pH 3110/SET WTW, Germany). pH value was measured three times for each sample (Ockerman 1985).

Phenolic compounds in AP and MwP

The individual phenolic compounds in AP and MwP samples were detected using Shimadzu-HPLC (Shimadzu Corporation, Kyoto, Japan) equipped with a PDA detector (set at 280 and 330 nm). In brief, 20 µl of samples and authentic external standards of phenolic compounds were separately injected into the column**.** The injection volume was 20 µl and the flow rate of the mobile phase was 1 ml/min at 30 °C. The total run time per sample was 60 min. A mixture of mobile phase was consisted of 0.05% acetic acid in water (A) and acetonitrile (B). The gradient programme was employed: 0–0.10 min 8% B; 0.10–2 min 10% B; 2–27 min 30% B; 27–37 min 56% B; 37–37.10 min 8% B; 37.10–45 min 8% B. The chromatograms were recorded at 280 nm. The standard external method was used for the quantitative analysis (Babiker et al. 2021).

Determination of cooking yields and dimensional shrinkage

Cooking yields and dimensional shrinkage were determined according to the method specified by Jones et al. (1992) and Murphy et al. (1975) as in the following:

$$cooking\ yield(\%) = \frac{weight\ of\ cooked\ patties}{weight\ of\ raw\ patties} x100$$

$$DS\ (\%) = \frac{(RT - CT) + (RD - CD)}{RT + RD} X100$$

DS : Dimensional shrinkage

RT : Raw thinckness

RD : Raw diameter

CT : Cooked thickness

CD : Cooked diameter

Thiobarbituric acid reactive substances (TBARS) value

The oxidative rancidity of the samples was measured as thiobarbituric acid reactive substances (TBARS) according to Tarladgis et al. (1960). The results were read in a Spectrophotometer (UV- 160 A, UV- Visible Recorder) and calculated as mg malondialdehyde/kg patties.

Texture profile analysis (TPA)

Patties were shaped into (36 mm diameter, 13 mm height, 20 g weight). The textural properties (chewiness, hardness, cohesiveness, adhesiveness and springiness) the samples were measured by using a texture analyser with 50 kg load cell and 36 mm diameter probe (Stable Micro Systems TA.HD Plus, TA, Stable Microsystems Godalming, Surrey, UK) (Palamutoğlu and Sarıçoban, 2016).

Sensory properties

The samples were evaluated for colour, odour, flavour and taste, texture, appearance, and general acceptability. The patties were cooked in a pre-heated grill for 6 min each side (to give an internal temperature of 72 ± 2 °C), then cooled to 30±1 °C and served to the panellist on a white plate. Samples were tasted in one session per day and by 10 people per session. Samples were served randomly to the panellists. All semi-trained panellists were between 20 and 30 years old. Panellists evaluated the sensory analyze using a 9-point hedonic scale (1 = dislike extremely, 9 = like extremely) (Yıldız Turp & Serdaroğlu 2010).

Statistical analysis

Each parameter was performed two replication and the measures were performed in triplicate. One-way analysis of variance was performed for all variables, using the MINITAB for Windows Release 18. Tukey Multiple Comparison Tests were used to determine the differences among the means at a 5% significance level. The results were presented as the mean values ± standard error.

3. Results and Discussion

Phenolic compounds of peach leaves

The phenolic compounds of AP and MwP are given in Table 1. (+)-Catechin (2.84 mg/100 g), 1,2-Dihydroxybenzene (1.35 mg/100 g), Quercetin (1.02 mg/100 g) were the most abundant phenolics found in AP.(+)-Catechin (2.42 mg/100 g), 3,4-Dihydroxybenzoic Acid (2.06 mg/100 g), Gallic Acid (1.04 mg/100 g) were the major phenolic compounds found in MwP.

Table 1
Phenolic compounds of peach leaves dried in the air and in the microwave oven

Phenolic compounds	Concentration (mg/100 g)	
	AP	MwP
Gallic Acid	0.48±0.11	1.04±0.22
3,4-Dihydroxybenzoic Acid	0.73±0.06	2.06±1.02
(+)-Catechin	2.84±0.76	2.42±0.73
1,2-Dihydroxybenzene	1.35±0.89	1.06±0.39
Syringic Acid	0.40±0.14	0.55±0.27
Caffeic Acid	0.22±0.09	0.53±0.18
Rutin trihydrate	0.19±0.08	0.70±0.27
p-Coumaric Acid	0.22±0.14	0.50±0.13
trans-Ferulic Acid	0.58±0.13	0.07±0.05
Apigenin 7 glucoside	0.29±0.09	0.26±0.20
Resveratrol	0.55±0.18	0.58±0.13
Quercetin	1.02±0.13	0.72±0.20
trans-Cinnamic Acid	0.08±0.01	0.29±0.08
Naringenin	ND	0.09±0.01
Kaempferol	0.70±0.14	0.82±0.00
Isorhamnetin	0.78±0.35	0.38±0.13

AP: Peach leaves dried in the air, MwP: Peach leaves dried in the microwave oven. ND: Not determined

Phenolic content of the peach leaf has been influenced by drying method. Lian Sen et al. (1994) reported the presence of 5,7- dimethoxycoumarin, gallic acid, kaempferol and kaempferol derivatives (3,7-dirhamnoside, 3- rutionoside), quercetin, quercetin derivatives (3-rhamnoside, 3- rutinoside, 3-galactoside, 3-glucoside, 3-sophoriside) in peach leaves. Similar to our study results, Aouidi et al. (2016) dried olive leaves by lyophilized, convection and microwave drying and the highest antioxidant quality was seen in the microwave drying at 600 W.

Physicochemical properties of beef patties

There were no differences in cooking yield (%) of patties (*P>0.05*). As seen in Table 2, percentage cooking yields were ranged from 62.50 to 67.65 %. Al-Juhaimi et al. (2016) stated that using Moringa seed powder increased the cooking yield of samples compared to control group. On the other hand, dimensional shrinkage of the control group was higher than those other patties, the least dimensional shrinkage (7.48%) occurred in MwP3. The dimensional shrinkage decreased with the increasing concentration of MwP (Table 2). Similarly, dimensional shrinkage decreased in patties to which destoned olive cake powder was added and it has been stated that the olive pulp allows to preserve size and shape of the samples throughout the cooking process (Aouidi et al 2016). Alakali et al., (2010) stated that muscle protein denaturation, removal of melted fat and evaporation of some water during heat treatment resulted in shrinkage in patties. In our study, shapes of the beef patties effected by changes in the protein structure because of cooking process of the samples.

Table 2
Cooking yield and dimensional shrinkage values of raw beef patties containing different levels of peach leaf powders

Treatments	Cooking yield (%)	Dimensional shrinkage (%)
Control	67.30 ± 2.28^{A}	12.31 ± 0.55^{AB}
BHT	64.12 ± 1.58^{A}	14.47 ± 0.45^{A}
AP	67.65 ± 1.66^{A}	7.48 ± 0.81^{B}
MwP1	62.59 ± 0.69^{A}	9.32 ± 0.75^{AB}
MwP2	65.52 ± 1.00^{A}	12.80 ± 0.20^{AB}
MwP3	65.76 ± 0.82^{A}	11.88 ± 0.49^{AB}
Significant	*NS*	*

Values are means of triplicate samples (±SE). NS – not significant ($P > 0.05$) $^{A–B}$ Means within columns with different superscript letters are significantly different *(*P<0.05)*.
Control: Raw patties without peach leaf powders (PLP) and BHT. BHT: Raw patties with 0.01% butylhydroxytoluene (BHT). AP: Raw patties 1% peach leaf powder dried in air. MwP1: Raw patties with 0.5% peach leaf powder dried in microwave oven. MwP2: Raw pattis with 1% peach leaf powder dried in microwave. MwP3: Raw patties with 2% peach leaf powder dried in microwave.

The pH values of the samples are given in Table 3. The pH of uncooked samples containing various concentrations of peach leaf powder decreased (*P<0.01*) (Table 3). pH values of control and BHT were determined as 6.29, 6.16, respectively; the pH values of MwP1, MwP2, MwP3 and AP samples were found as 5.75,5.70,5.67 and 6.06, respectively. Among all treatment groups for storage days, the lowest pH value (5.49) was 2% MwP on day 5 day, the highest pH (6.71) was seen in control group on day 7.

Lipid oxidation value

The peach leaf powders (PLPs) showed an important inhibitory influence on the TBARS values (Table 3). TBARS values were found between 0.66 and 4.15 MDA mg/kg for 7 days. The addition of PLPs effectively decreased the lipid oxidation values. TBARS values of control, BHT and MwP3 were 2.64, 1.31, 0.75 mg of MDA/kg meat at first day of storage respectively, were 4.13, 1.94, 0.58 mg of MDA/kg meat at the end of the storage day, respectively. Means of TBARS values were higher in the without PLP group than in those containing AP, MwP and BHT. Among all treatment groups, the average lowest TBARS value was MwP3 over the storage period (Table 3). Phenolic compounds and flavonoids in the structure of the PLP are thought to be effective in delaying oxidation. Similarly, Zahid et al. (2019) stated that beef patties treated with BHT, ascorbic acid, and clove extract manifested substantially lower than the control group. Juntachote et al. (2007) also determined that the dried galangal powder decreased the lipid oxidation values of cooked pork meat (*P<0.05*) than the control during storage period. They also indicated that TBARS values increased with progressing storage time In a study, using leaf extracts as a natural preservative in meat products, polyphenolic extracts of black currant and cherry leaves were added to the pork sausages. In the sausages stored for 28 days, leaf extracts showed a

significant inhibitory effect on TBARS formation (Nowak et al. 2016). In a study using olive leaf powder and extract, olive leaves reduced lipid oxidation by 20-25% (Aouidi et al. 2016).

Table 3
The pH and TBARS values of raw beef patties treated with peach leaf powders at different levels during storage at 4 ºC for 7 days

Treatments	Storage time (days)			
	1	3	5	7
pH				
Control	5.89±0.04^{Ba}	6.18±0.25^{Aba}	6.39±0.04^{Aba}	6.71±0.09^{Aa}
BHT	5.90±0.05^{Ba}	5.97±0.19^{Aba}	6.36±0.10^{ABa}	6.42±0.11^{Aa}
AP	6.00±0.04^{Aa}	5.85±0.18^{Aa}	6.18±0.19^{Aab}	6.20±0.22^{Aab}
MwP1	5.95±0.05^{Aa}	5.53±0.07^{Aa}	5.73±0.20^{Abc}	5.80±0.15^{Abc}
MwP2	5.92±0.06^{Aa}	5.79±0.03^{Aba}	5.57±0.11^{Bc}	5.53±0.05^{Bc}
MwP3	6.02±0.04^{Aa}	5.68±0.06^{Ba}	5.50±0.09^{Bc}	5.49±0.04^{Bc}
TBARS (mg MDA/kg)				
Control	2.64±0.29^{Ba}	3.76±0.38^{Aa}	4.15±0.13^{Aa}	4.14±0.17^{Aa}
BHT	1.31±0.31^{Abc}	1.87±0.35^{Abc}	2.04±0.33^{Ab}	1.94±0.27^{Ab}
AP	1.17±0.08^{Abc}	0.66±0.06^{Cd}	0.92±0.02^{Bc}	0.87±0.04^{BCcd}
MwP1	2.02±0.24^{Aab}	2.24±0.41^{Ab}	1.89±0.31^{Ab}	2.67±0.62^{Ab}
MwP2	1.41±0.23^{Abc}	1.27±0.17^{Abcd}	1.28±0.18^{Abc}	2.16±0.52^{Abc}
MwP3	0.75±0.04^{Ac}	1.06±0.19^{Acd}	0.77±0.11^{Ac}	0.67±0.07^{Ad}

Values are means of triplicate samples (±SE)
$^{a-d}$ Means within columns with different superscript letters are significantly different *(P<0.01)*.
$^{A–C}$ Means within rows with different superscript letters are significantly different (*P<0.01*).
Control: Raw patties without peach leaf powders (PLP) and BHT. BHT: Raw patties with 0.01% butylhydroxytoluene (BHT). AP: Raw patties 1% peach leaf powder dried in air. MwP1: Raw patties with 0.5% peach leaf powder dried in microwave oven. MwP2: Raw patties with 1% peach leaf powder dried in microwave. MwP3: Raw patties with 2% peach leaf powder dried in microwave

Texture profile analysis (TPA)

Table 4 indicates the influence of PLPs on the hardness, gumminess, chewiness parameters of uncooked beef patties. Hardness, gumminess (N), chewiness of the samples increased (*P < 0.01*) using the MwP concentration. The highest hardness (32.84 N), gumminess (11.62 N), chewiness (7.08) values were observed in MwP3 while the lowest values were seen in control group. Sharma and Yadav (2020) stated that the hardness value of chicken meat patties incorporating pomegranate peel and pomegranate aril bagasse flour increased. In our previous study, adding grape leaf powder affected the hardness, chewiness characteristics of meatball samples (Yaldız Cabi and Sarıçoban, 2019). However, Modi et al. (2009) found that some vegetable material caused to decrease chewiness and hardness (N) parameters of meat samples. Springiness (mm) and cohesiveness values of cooked meat were affected by the addition of PLPs. Springiness (mm) values changed from 0.86 (AP) to 0.90 (MwP1 and MwP3). Cohesiveness values are between 0.39 (control) - 0.59 (BHT and MwP2).

Table 4
Textural parameters (TPA) of raw and cooked beef patties treated with different levels of peach leaf powders

Treatments	Hardness (N)	Gumminess (N)	Springiness (mm)	Cohesiveness	Chewiness
Raw					
Control	19.79±0.85^{C}	7.55±0.53^{B}	0.56±0.01^{A}	0.38±0.01^{A}	4.26±0.38^{B}
BHT	29.32±0.79^{AB}	10.46±0.24^{A}	0.66±0.02^{A}	0.35±0.01^{A}	6.95±0.24^{A}
AP	24.11±1.11^{BC}	9.02±0.21^{AB}	0.62±0.02^{A}	0.37±0.02^{A}	5.69±0.34^{AB}
MwP1	26.37±0.57^{B}	10.66±0.60^{A}	0.64±0.05^{A}	0.37±0.00^{A}	6.84±0.50^{AB}
MwP2	24.36±0.28^{BC}	8.94±0.31^{AB}	0.56±0.00^{A}	0.38±0.00^{A}	5.07±0.24^{AB}
MwP3	32.84±2.04^{A}	11.62±0.77^{A}	0.60±0.03^{A}	0.35±0.00^{A}	7.08±0.84^{A}
Significant	**	**	*NS*	*NS*	*
Cooked					
Control	205.13±1.61^{A}	121.40±10.17^{A}	0.89±0.00^{AB}	0.39±0.02^{B}	109.30±9.26
BHT	250.00±20.21^{A}	146.38±7.83^{A}	0.87±0.00^{AB}	0.59±0.02^{A}	127.78±7.54
AP	205.60±11.80^{A}	116.16±4.99^{A}	0.86±0.00^{B}	0.56±0.01^{A}	100.54±3.79
MwP1	199.00±8.86^{A}	119.04±4.98^{A}	0.90±0.00^{AB}	0.54±0.02^{A}	107.12±4.16
MwP2	203.40±15.96^{A}	116.75±5.24^{A}	0.88±0.00^{AB}	0.59±0.02^{A}	104.79±5.46
MwP3	240.90±23.11^{A}	112.90±8.74^{A}	0.90±0.01^{A}	0.51±0.04^{AB}	101.98±7.18
Significant	*NS*	*NS*	**	**	*NS*

Values are means of triplicate samples (±SE). NS – not significant (*P > 0.05*). $^{A-C}$ Means within columns with different superscript letters are significantly different (**P<0.05; **P<0.01*).

Control: Raw patties without peach leaf powders (PLP) and BHT. BHT: Raw patties with 0.01% butylhydroxytoluene (BHT). AP: Raw patties 1% peach leaf powder dried in air. MwP1: Raw patties with 0.5% peach leaf powder dried in microwave oven. MwP2: Raw pattis with 1% peach leaf powder dried in microwave. MwP3: Raw patties with 2% peach leaf powder dried in microwave.

Sensory scores

No significant differences (*P>0.05*) were observed in the flavour and taste, odour, structure and texture properties. However, the addition of PLPs affected (*P<0.05*) the colour, appearance, general acceptability of beef patties. The panellists preferred the colour of the control patties and patties with BHT (Table 5). The increase in the concentration of the PLP was noticed by the panellists in terms of colour and the concentration increase and the score given to the color decreased (Table 5). The patties were examined in terms of appearance; the highest score was given to the control group. The patties with MwP3 were less preferred by the panellists than the other groups. This situation is probably due to the increase in fibre ratio in leaves may have hardened the structure of patties. The highest general acceptability score was given to the MwP1 group; the lowest score was given to MwP3 (Table 5).

Table 5
The sensory evaluation of cooked beef patties containing different levels of peach leaf powders

Treatments	Colour	Appearance	Odour	Flavour and taste	Texture	General acceptability
Control	7.25±0.49^{AB}	7.62±0.24^{A}	5.87±0.72	5.75±0.49 ^{AB}	6.87±0.60	6.87±0.33 ^{AB}
BHT	7.50±0.47^{A}	6.75±0.46^{AB}	4.62±0.61	5.00±0.36 ^{AB}	5.62±0.46	5.87±0.37 ^{AB}
AP	5.87±0.74^{ABC}	6.62±0.39^{AB}	5.50±0.53	5.25±0.86 ^{AB}	5.50±0.81	5.37±0.81 ^{AB}
MwP1	6.62±0.61^{AB}	7.25±0.42^{A}	6.37±0.50	6.75±0.46 ^{A}	6.75±0.29	7.12±0.37 ^{A}
MwP2	4.75±0.68^{BC}	6.12±0.41^{AB}	5.50±0.40	5.00±0.61 ^{AB}	4.87±0.51	5.62±0.43 ^{AB}
MwP3	3.87±0.48^{C}	5.00±0.50^{B}	5.25±0.46	3.75±0.81 ^{B}	5.12±0.67	4.87±0.41 ^{B}
Significant	**	**	*NS*	*NS*	*NS*	*

Values are means of triplicate samples (±SE). NS – not significant (*P>0.05*). $^{A-C}$ Means within columns with different superscript letters are significantly different (**P<0.05; **P<0.01*).

Control: Raw patties without peach leaf powders (PLP) and BHT. BHT: Raw patties with 0.01% butylhydroxytoluene (BHT). AP: Raw patties 1% peach leaf powder dried in air. MwP1: Raw patties with 0.5% peach leaf powder dried in microwave oven. MwP2: Raw pattis with 1% peach leaf powder dried in microwave. MwP3: Raw patties with 2% peach leaf powder dried in microwave.

4. Conclusions

The usage of ground peach leaf has an important effect on TBARS values througout the storage time. The PLP dried in microwave oven retarded the lipid oxidation of beef patties when compared to the AP group. Especially, MwP3 significantly prevented lipid oxidation. Sensory properties had been affected by the peach leaves, while the addition of PLP showed a hard texture. Further studies are required for revealing the microbiological properties of the beef patties.

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