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ANTIOXIDANT PROPERTIES OF TURMERIC RHIZOME AND LEAF (*CURCUMA LONGA. L)* AND ITS EFFECTS ON THE OXIDATIVE STABILITY OF BEEF PATTY

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ABSTRACT

Beef patties are made from meat. Meat contains the most protein among all foods and contains essential amino acids required in human diet. Nonetheless, beef patties are susceptible to oxidative deterioration, which is the source of limitation in the quality of the beef patty. This is due to lipid oxidation that produces products such as ketones, alcohols, aldehydes, and other toxic compounds. These substances have an adverse effect on colour, texture, and flavour. Thus, this study will focus on the antioxidant incorporation of the turmeric rhizome and leaf into the beef patty. The antioxidant activity of turmeric rhizome extract (TRE) and turmeric leaf extract (TLE) was analysed using three different methods which are Free Radical Scavenging (DPPH), Ferric Reducing Antioxidant Power (FRAP) and Total Phenolic Compound (TPC). Peroxide Value (PV) was performed on the beef patty incorporated with turmeric rhizome extract. This study assessed the antioxidant characteristics of turmeric rhizome extract and turmeric leaves extract, and whether turmeric rhizome extract exhibited antioxidant properties when added to beef patties.

Key Words: Turmeric, rhizome, beef patty, lipid oxidation, antioxidant

1. INTRODUCTION

Meat and meat products are essential components of the human diet, providing high-quality protein and essential fatty acids. However, proper storage and conditions are crucial for the quality of meat products, such as beef patty. Lipid oxidation, a chemical reaction that breaks down lipids, can lead to deterioration and negatively impact the quality of meat and human health. Synthetic antioxidants like BHA and BHT are commonly used in the food industry to address fat stability issues. However, consumers are increasingly adopting natural raw materials and formulations due to increased health awareness. Lipid oxidation produces toxic compounds, such as ketones, alcohols, aldehydes, and other toxic compounds, which negatively impact colour, texture, and flavour. Turmeric and its leaves are often consumed, but few studies have been conducted on their antioxidant activity as food antioxidants. Therefore, it is crucial to study the antioxidant activities of turmeric rhizomes and leaves as a natural antioxidant to maximize their use in Malaysia. The quality deterioration caused by lipid oxidation significantly impacts consumers' preference and concern towards beef patty consumption.

2. METHODOLOGY

2.1. Sample Extraction

The study used water as a solvent for solvent extraction, following the method of Saleh et al. (2022). The powdered sample was extracted with 600 ml boiling water for 10 minutes, filtered, dried on a rotary evaporator, and then freeze-dried for three days. The yield of the extracts was recorded and stored at room temperature for further analysis. The percentage total extract yield was calculated.

2.2. Determination of Antioxidants Activity

Total Phenolic Compound (TPC) was done according to method described by Sukati & Khobjai (2019). The final blue colour solution formed was determined spectrophotometrically at 760 nm. Triplicate and average were performed. Free Radical Scavenging Assay (DPPH) analysis was done according to Sukati & Khobjai, (2019) while Ferric Reducing Antioxidant Power (FRAP) was done according to Vijayalakshmi & Ruckmani, (2016).

2.3 Beef patty production

A meat grinder was used to grind fresh meat, dividing it into two batches for analysis. The beef patties were made in a food processing laboratory using a recipe of 250g lean beef meat, 5g salt, 10g white pepper, and 5g sugar. Turmeric rhizome extract was mixed into the mixture, keeping the temperature below 10^{o}C. The patties were prepared using a hand-held patty maker and stored at 4^{o}C for lipid oxidation analysis. The patties were measured three days apart for nine days, and their Peroxide Value (PV) was analysed for each day.

2.4 Determination of oxidative stability of beef patty

2.4.1 Lipid Extraction

This method was in accordance with Ortuño *et al*. (2021) method for lipid extraction in beef patty, which involves extracting the lipid portion using a chloroform: methanol solution. The organic phase is separated and dried, and the fat content is determined gravimetrically using the peroxide value method.

2.4.2 Peroxide Value (PV)

This analysis was performed according to the method done by Alhendi *et al.* (2017), with some modification. Approximately 3.0 ml beef patty extract was added into a clean and dry conical flask. Then a 30 mL solvent mixture (glacial acetic acid: Chloroform, 3:2) was added into the sample. The conical flask was shaken vigorously for less than 30 seconds. Then, 1.5 mL of saturated potassium iodide solution was added into the conical flask and let it stand for 1 minute. Next, 30 mL distilled water was added and followed by the addition of 1 ml starch indicator. The content inside the conical flask was then titrated with 0.01 M sodium thiosulphate solution. Simultaneously, the blank solution was determined.

3. RESULT & DISCUSSION

3.1 Extraction Yield

Extraction yield was determined as shown in Table 1.

Table 1: Total % Yield Extract of Turmeric Rhizome and Turmeric Leaf Sample

Sample	% of yield extract
Turmeric rhizome (TR)	7.49±0.15[a]
Turmeric leaf (TL)	5.28±0.11[b]

3.2 Determination of antioxidant activity

3.2.1 Total Phenolic Compound (TPC)

The study analysed the total phenolic content (TPC) of turmeric rhizome (TRE) and leaf extract (TLE) using a linear regression model. The results showed that TRE had a higher phenolic content (1.03±0.044[a]) compared to TLE (0.33±0.01[b]). This contradicts Burman *et al* (2020) report, which suggested that the leaf extract of turmeric had a higher total phenolic content. The difference in TPC could be attributed to factors such as active compounds, solvent, extraction process, and geographical location of turmeric plant cultivation. The trend of TPC values is similar to Chan and Lim (2007) study, which found that both turmeric rhizome and leaf had higher TPC values. Sepahpour *et al*. (2018) also found that the TPC value of turmeric rhizome extracted with water was 3.8 ± 0.1 mg GAE/g.

Table 2: Total Phenolic Compound of Turmeric Extracts

Sample	mg GAE/ g
Turmeric leaf extract (TLE)	0.33±0.01[b]
Turmeric rhizome extract (TRE)	1.03±0.04[a]

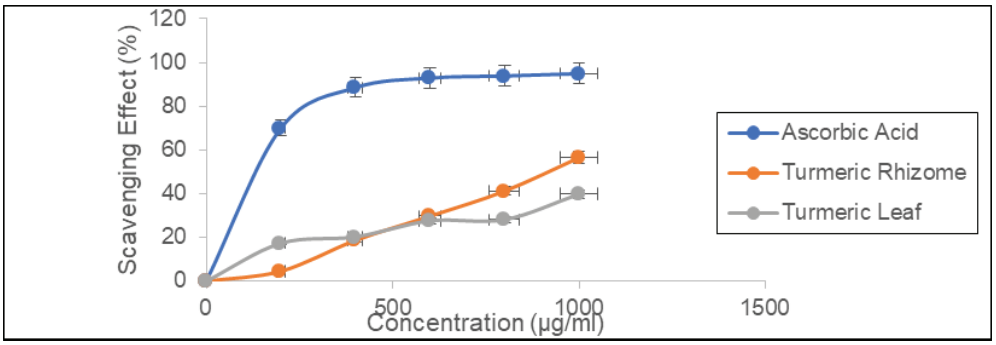

Figure 1: Scavenging Activity of Turmeric Rhizome and Turmeric Leaf

3.2.2 Free Radical Scavenging Assay (DPPH).

The scavenging effect of turmeric was measured at different concentrations, including 200, 400, 600, 800, and 1000 µg/ml. The DPPH scavenging effect of water extracts and standard was found to be 94.93%, 56.53%, and 39.87% at 1000 µg/ml. Ascorbic acid standard had the highest scavenging effect. TLE showed greater free radical scavenging activity at low concentrations. The scavenging effect of both samples was considered poor. Studies have reported high inhibition percentages for turmeric extract, with 83.89% at 500 µg/ml. However, the inhibition percentage of turmeric leaf was only 29.73% at 600 µg/ml.

3.2.3 Ferric Reducing Antioxidant Power (FRAP)

Turmeric, a plant with high antioxidant activity, exhibits a higher absorbance value than its leaves. The reducing power of turmeric samples, as indicated by the graph in Figure 2, increases with the concentration. The highest concentration (1000 µg/ml) is achieved with turmeric rhizome (2.283), ascorbic acid (2.001), and turmeric leaf (0.993). However, a study by Erdoğan and Erbaş (2021) found a lower absorbance value at 1000 µg/ml

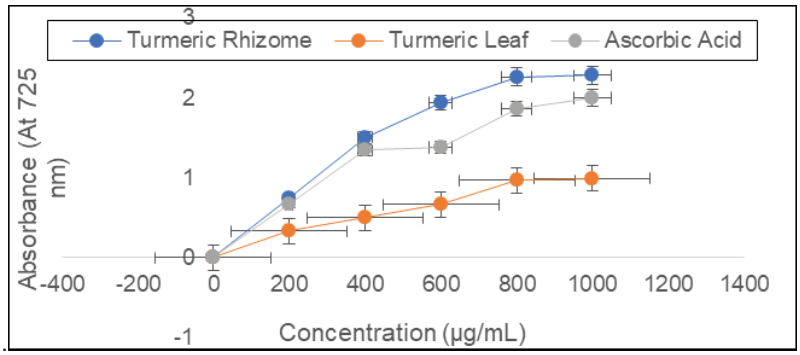

Figure 2: Ferric Reducing Antioxidant Power of Turmeric Rhizome and Turmeric Leaf Extract

3.3 Determination of oxidative stability of beef patty

3.3.1 Peroxide Value (PV)

The study found a significant difference in peroxide values of beef patty samples incorporating antioxidants compared to the control. The peroxide value increased proportionally with storage period, with the highest value observed on the last day. The same trend shown in the study of Sadeghinejad *et al*. (2019), which indicated that, during the entire chilled storage period, 4°C (excluding day 0), patties containing 500, 750, and 1000 mg/kg lyophilized pistachio green hull (LPGH) extract had significantly smaller peroxide values than the control. No significant difference was observed for TRE or ascorbic acid in the control beef patty, indicating a correlation between storage period and peroxide value.

Table 3: Peroxide Value of Beef Patty after 9 Days of Chilled Storage

	Interval			
	Day 0	**Day 3**	**Day 6**	**Day 9**
Control	2.56 ± 0.19^{Ca}	4.56 ± 1.07^{Ba}	5.33 ± 0.33^{Ba}	7.56 ± 0.51^{Aa}
Turmeric rhizome extract (TRE)	2.22 ± 0.19^{Cab}	2.73 ± 0.19^{Cb}	4.11 ± 0.69^{Bb}	6.33 ± 0.33^{Ab}
Ascorbic acid	1.89 ± 0.38^{Bb}	1.99 ± 0.33^{Bb}	2.56 ± 0.38^{Bc}	5.89 ± 0.77^{Ab}

Means within the column with same small letters are not significantly different ($p>0.05$),
Means within the row with same capital letters are not significantly different ($p>0.05$).

4. CONCLUSION & RECOMMENDATION

Turmeric rhizome, a natural antioxidant, has been found to reduce lipid oxidation in beef patty, according to three antioxidant assays: TPC, DPPH, and FRAP. The lower peroxide value of beef patty incorporated with turmeric rhizome extract (TRE) compared to the control patty without extract, but TRE had a higher peroxide value than ascorbic acid. Future studies should consider collecting turmeric samples from different locations, applying different extraction methods, and conducting

additional lipid oxidation analysis. Despite these findings, further research is needed to optimize the use of TRE in beef patty preservation.

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