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Effects of roasting conditions on sensory attributes, polyphenolic content and DPPH radical scavenging activity of peanut (*Arachis hypogaea*)

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ABSTRACT

Roasting is considered the commonest processing method applied to foods, it affects both phytochemicals and sensory attributes. In the present study, the effect of varying roasting parameters on sensory attributes was determined, as well as scavenging property against free radicals (DPPH) and polyphenolic content (TPC and TFC) of whole peanut kernels. Whole peanut kernels were roasted at different temperatures (130-150 °C) with various durations (5-20 min). Finding revealed that peanuts roasted at 130, 140, and 150 °C for 15, 10, and 5 min, respectively, received significantly the highest (p<0.05) sensory scores in all the parameters investigated. Therefore, they were selected for TPC, TFC, and DPPH assays. All three assays were found to increase during roasting compared to the unroasted counterpart. Peanuts that were roasted at 140 °C for 10 min, had the highest total phenolic contents of 67.26 ± 1.77 mg GAE/g while those roasted at 150 °C for 5 contained the highest TFC of 12.91 ± 0.56 mg QE/g. The highest DPPH radical scavenging activity was detected in the sample roasted at 140 °C for 10 min with an IC_{50} value of 417.44 µg/mL. Roasting significantly affected the bioactive contents as well as the scavenging activity of the whole peanut.

Introduction

Peanut (*Arachis hypogaea* L.) leguminous crop popularly cultivated in both tropical and subtropical regions, belongs to the family *Fabaceae* (Ziegler et al., 2017). The peanut leading producer is China with 41.5%, others are India and the United States of America (Attree et al., 2015). Peanut kernels are a good source of proteins and lipids. Lipids have a high content of tocopherols (Ferreira et al., 2016). The oil content in peanuts is approximately 50–55%, with 45% (18:1) of unsaturated fatty oleic and 35% (18:2) of linoleic acid (Nepote et al., 2006). Peanuts are mostly consumed after processing such as roasting. Roasting is a processing method applied to nuts and other foods in order to improve their sensory attributes such as flavour, aroma, crunchiness, and texture (Schlörmann et al., 2015). It is, however, dependent on certain parameters (Shakerardekani et al., 2011).

Sensory evaluation is widely used to measure oxidative damage as well as to evaluate the stability of nuts (Zajdenwerg et al., 2011). Sensory evaluation employs the use of testers who could be trained, semi-trained or those who are consumers. The evaluation of consumer acceptability provides essential and reliable information indicating the level of liking or preference for a product (Choi et al., 2007). The use of low to medium temperatures reported the highest scores

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(Schlörmann et al., 2015). However, the temperature of 185 °C leads to the development of a strong burnt and bitter flavour. Nepote et al. (2007) noted a significant differences in the attributes (colour, flavour, and texture) on the five-point hedonic scale among the investigated roasted peanuts, and those overlaid with algarrado and pear syrups (RP-P and RP-A). From the descriptive results, the two coated peanuts (RP-A and RP-P) showed higher intensity than RP due to the coated layer. Riveros et al. (2009) conducted a consumer analysis of two different peanut pastes and no significant difference was found. Nepote et al. (2006) reported no significant difference in the sensory attributes of normal and high oleic peanuts.

Peanut is mostly consumed after blanching. Peanut skins (PS) constitute about 3.0% of peanut seed which is discarded during processing. PS is a cheap source of dietary fibre (Ma et al., 2014), and it is a by-product that may serve as an important material in the production of high-value substances (Ebringerová et al., 2008). It was reported that phytochemicals are predominantly found in the outer layers of plant foods, which are meant to protect the internal tissue (Ma et al., 2014; Dogara et al., 2022). Extracts of Brazil nut skin exhibited potent antioxidant property (John and Shahidi, 2010), and authors reported a significantly higher phenolic content than in the whole nut and kernel. This showed that most of the phenolic compounds found in the nuts were predominantly found in their skins. Moreover, Lemos et al. (2012) reported the highest DPPH and approximately 50% of the TPC of barunuts were concentrated in the skin. Ma et al. (2014) observed TPC increment in peanut butter supplemented with varying proportions of peanut skin, compared to the control sample. Based on the foregoing evidence, the consumption of whole nuts will enhance the bioavailability of the phenolic compounds and may contribute to human health. Furthermore, it will reduce waste disposal. The effect of roasting on phytochemicals and sensory parameters of blanched peanuts was investigated in many studies. However, there is a lack of studies examining the whole peanut. Hence, this study aimed to determine the effect of roasting on sensory parameters, phenolic contents, and scavenging activity of whole peanuts.

Materials and methods

Materials

The sample was purchased in Kuala Terengganu, Malaysia. Upon arrival at the laboratory, it was ensured that the sample was free from unwanted material and stored in the refrigerator (4 °C). Relative humidity was 85-90%. The major reagents used were: 1,1-diphenyl-2-picrylhydrazyl (DPPH) and Na_2CO_3; standard polyphenols used were trihydroxybenzoic acid and $C_{15}H_{10}O_7$. They were purchased in either Switzerland or Germany.

Roasting

Roasting was carried out in the Firenzzi electric oven (TO-1148). The peanut kernels were placed in a perforated rotating wire mesh. The wire mesh was allowed to rotate for air circulation around the peanut kernels. This was done to ensure the heat was distributed evenly for a perfect roast. Peanut kernels were placed in an oven that reached the desired roasting condition. Peanut kernels were allowed to roast for 5, 10, 15, or 20 min at 130, 140, and 150 °C (±2 °C). The roasting was carried out in duplicate. A type-K thermometer (51-54 series I) was placed in between the two heating plates near the rotor, holding the sample to monitor the temperature during roasting. When the roasting was done, they were kept and cooled at room temperatures (25-27 °C), weight loss was recorded, they were packed, and placed at 4 °C until needed.

Colour measurement

Hunter colourimeter Minolta Chromo Meter CR 400 (Minolta, Osaka, Japan) was used to measure L*, a*, and b* of the roasted samples. L* has a scale from 0 to 100; the higher value indicates whiteness and vice versa, a*, when positive, indicates red and negative value indicates green. On the other hand, b* positive value indicates yellow while negative value indicates blue (Lima and Guraya, 2005).

Sensory analysis

Semi-trained male and female panellists performed the sensory analysis of the samples. They were allowed to join based on the fact that they were not too old, nor too young, they liked peanuts, and they were supposed to be available during the sensory analysis. All testers were staff and students of the Faculty of Bioresources and Food Industry, Universiti Sultan Zainal Abidin, Terengganu, Malaysia. Approximately 5 g of roasted peanuts were placed in a small container labelled with numbers for identification along with crackers and water. The judges were instructed to evaluate four sensory parameters: colour, flavour, crunchiness, and overall acceptability. The judges rated attributes using a 9-point hedonic scale, where 1 = dislike extremely and 9 = like extremely (Mexis and Kontominas, 2009). They were also instructed to use the cracker or water to remove the palate.

Extraction

Roasted and unroasted peanut kernels were first finely ground, and in a 250 mL flask, a quantity of 1:10 of methanol (100 %) was used for the extraction by maceration. The mixture was left in the laboratory condition for a day. Whatman number 1 filter paper was used to filter the supernatant and was later concentrated using a rotary evaporator and kept at an appropriate condition till needed (Ma et al., 2014).

Estimation of TPC

Accurately 0.25 mL of methanol extract of roasted and unroasted peanuts was mixed with diluted Folin Ciocalteu (FC) reagent (1.25 mL) and allowed to rest for 5 min. A known volume of a prepared Na_2CO_3 (7.5%) was also added to the mixture and exposure to light was prevented for 30 min after which the reading was taken using a UV-Vis spectrophotometer at 765 nm. Trihydroxybenzoic acid (gallic acid) was the standard that was used (Singleton et al., 1998).

Estimation of TFC

The estimation was done by mixing an equal volume of a known amount of sample with methanol. Then, an equal volume of diluted aluminium chloride and a known amount of potassium acetate, and 1.4 mL of distilled water was added to the mixture wrapped with aluminium foil and allowed to rest for thirty minutes preventing the exposure of mixture to light. The reading was taken at 415 nm. Quercetin was used as standard flavonoid (Adedayo et al., 2010).

Assay for DPPH

A slightly modified procedure of Win et al. (2011) was used. A five-fold DPPH solution was added to the different concentrations of a known amount of the extract, and the mixture was protected from exposure to light for 30 min before measurement was taken at 515 nm. BHA and quercetin were the standard used. The inhibition (%) was computed utilizing the formula below

$$(\%)\ \boldsymbol{inhibition} = \frac{(\boldsymbol{A_0} - \boldsymbol{A_1})}{\boldsymbol{A_0}} \cdot \mathbf{100}$$

where A_0 is the absorbance of the control and A_1 is the absorbance of the sample.
The graph of the scavenging percentage against the extract concentrations was used to determine the IC_{50} values.

Statistical analysis

SPSS 18 version software was used. All findings are shown as the mean ± standard deviation of triplicate measurements. Analysis of variance (ANOVA) and Duncan as a post hoc test were conducted to determine differences between means. 5% was used to establish significant differences.

Results

CIE colour

Table 1 shows the L* a* b* colour measurement of roasted and unroasted peanuts. L* significantly ($p<0.05$) reduced at all roasting conditions, peanuts roasted at 140 °C for 20 min had the lowest L* value while a* and b* were found to increase in all roasting conditions. However, this indicates that roasting does not affect b* value when the sample was roasted at 130 °C and 150 °C for 20 min. Meanwhile, there was a significant difference in the b* value of samples roasted at 130 °C and 140 °C for 15 min and 20 min, respectively.

Sensory analysis

Table 2 shows the scores of whole peanuts roasted at varying conditions. All attributes investigated were within the range of acceptability on the 9-point hedonic scale except peanuts roasted at 130 °C for 5 min and 20 min, peanuts roasted at 140 °C for 5 min and peanuts roasted at 150 °C for 20 min which received a score of less than 6.

TPC and TFC

TPC and TFC of roasted and unroasted peanut kernels are shown in Table 3. The TPC ranged from 39.34 to 67.26 mg GAE/g. Roasted peanuts (140 °C, 10 min) had the highest TPC values while the lowest were found in the unroasted peanut.
The results of TFC were between 4.12 to 12.91 mg QE/g in the following order: unroasted < 140/10 ≤ 130/15 < 150/5.

DPPH

The property of both roasted and unroasted peanuts are shown in Table 4. Roasting significantly increased at all roasting conditions. The highest scavenging property was seen in the sample roasted at 150 °C for 5 min even though the difference was not significant across the roasting conditions.

Table 1. Colour values of unroasted and roasted whole peanuts

Time (min)	L*	a*	b*
	130 °C		
unroasted	55.36 ± 1.71^{a}	12.47 ± 0.55^{c}	25.88 ± 0.62^{b}
5	45.24 ± 0.37^{b}	17.90 ± 0.66^{b}	28.83 ± 0.68^{a}
10	40.53 ± 1.02^{c}	17.43 ± 0.86^{b}	27.68 ± 0.23^{a}
15	30.90 ± 0.94^{e}	22.10 ± 0.27^{a}	22.45 ± 0.63^{c}
20	36.45 ± 0.96^{d}	14.83 ± 3.92^{bc}	24.46 ± 1.65^{b}
	140 °C		
unroasted	55.36 ± 1.71^{a}	12.47 ± 0.55^{c}	25.88 ± 0.62^{b}
5	37.0 0 ± 2.21^{b}	18.29 ± 0.08^{b}	24.26 ± 1.71^{ab}
10	37.36 ± 1.66^{b}	17.29 ± 1.82^{b}	25.66 ± 2.15^{a}
15	35.67 ± 0.91^{b}	10.25 ± 1.17^{d}	14.47 ± 1.56^{c}
20	23.51 ± 0.50^{c}	20.60 ± 0.26^{a}	22.63 ± 0.24^{b}
	150 °C		
unroasted	55.36 ± 1.71^{a}	12.47 ± 0.55^{c}	25.88 ± 0.62^{b}
5	41.72 ± 0.98^{b}	21.26 ± 0.38^{a}	28.01 ± 0.38^{a}
10	37.12 ± 0.98^{c}	18.58 ± 0.79^{bc}	26.48 ± 0.31^{ab}
15	31.71 ± 1.88^{d}	17.62 ± 1.66^{c}	24..56 ± 2.11^{b}
20	30.77 ± 0.64^{d}	19.49 ± 0.78^{b}	19.24 ± 0.21^{c}

Values represent means ± standard deviation (n = triplicate). Values in each column having different letters are significantly different.

Table 2. Sensory scores of whole roasted peanuts

Roasting temperature (°C)	Time (min)	Colour	Flavour	Crunchiness	Overall acceptability
130	5	6.02 ± 1.41^{b}	5.77 ± 1.10^{c}	5.08 ± 1.27^{c}	5.68 ± 1.19^{b}
	10	6.85 ± 0.86^{a}	6.70 ± 0.96^{a}	6.92 ± 0.84^{a}	7.13 ± 0.79^{a}
	15	6.67 ± 0.85^{a}	6.40 ± 1.23^{ab}	6.95 ± 0.74^{a}	7.12 ± 0.93^{a}
	20	6.40 ± 0.99^{ab}	5.97 ± 1.03^{b}	6.28 ± 0.94^{b}	6.07 ± 0.82^{b}
140	5	6.58 ± 0.86^{a}	5.98 ± 0.93^{b}	5.98 ± 0.84^{b}	6.05 ± 0.74^{c}
	10	6.67 ± 0.86^{a}	6.63 ± 0.75^{a}	6.82 ± 0.89^{a}	7.03 ± 0.73^{a}
	15	6.30 ± 0.73^{a}	6.00 ± 0.91^{b}	6.50 ± 0.84^{a}	6.35 ± 0.73^{bc}
	20	6.67 ± 0.79^{a}	6.62 ± 0.61^{a}	6.92 ± 0.71^{a}	6.63 ± 0.56^{b}
150	5	6.83 ± 0.88^{a}	6.77 ± 0.96^{a}	6.92 ± 0.73^{a}	7.20 ± 0.64^{a}
	10	6.62 ± 0.88^{a}	6.32 ± 0.77^{ab}	6.43 ± 0.73^{b}	6.58 ± 0.66^{b}
	15	6.67 ± 0.63^{a}	6.03 ± 0.98^{b}	6.37 ± 0.69^{b}	6.23 ± 0.87^{b}
	20	5.77 ± 1.01^{b}	5.68 ± 1.22^{c}	6.38 ± 0.72^{b}	5.58 ± 0.97^{c}

Values represent means ± standard deviation (n = 3). Values within each column with different letters are significantly different

Table 3. TPC and TFC of unroasted and roasted whole peanuts

Roasting temperature/Time (°C/min)	TPC (mg GAE/g)	TFC (mg QE/g)
Unroasted	39.34 ± 3.65^{c}	4.12 ± 0.14^{c}
130/15	54.95 ± 2.27^{b}	11.16 ± 0.39^{b}
140/10	67.26 ± 1.77^{a}	10.22 ± 0.43^{b}
150/5	53.89 ± 2.59^{b}	12.91 ± 0.56^{a}

Values are mean ± standard deviation for three replicates. Mean values in the same column with different superscript letters are significantly different

Table 4. DPPH scavenging property (% and IC_{50}) of unroasted and roasted whole peanuts

Roasting temperature/time (°C/min)	Inhibition (%)	IC_{50} (µg/mL)
Unroasted	71.52 ± 1.12^{b}	697.96 ± 31.84^{a}
130/15	93.14 ± 0.90^{a}	471.44 ± 3.47^{b}
140/10	91.95 ± 0.98^{a}	417.44 ± 8.58^{d}
150/5	93.73 ± 0.39^{a}	442.41 ± 3.23^{c}
BHA	88.38 ± 4.93^{a}	17.27 ± 0.77^{e}
Quercetin	94.12 ± 0.42^{a}	11.57 ± 0.77^{e}

Values are mean ± standard deviation for three replicates. Mean values in the same column with different superscript letters are significantly different

The IC_{50} of roasted and unroasted peanuts is shown in Table 4.

The IC_{50} varied from 417.44 µg/mL to 697.96 µg/mL. Peanut roasted at 140 °C for 10 min exhibited the highest property, and unroasted peanut kernels exhibited the lowest scavenging properties.

Correlation between DPPH, TPC and TFC

Correlation coefficients between DPPH, TPC, and TFC are shown in Table 5. Both TPC and TFC were highly correlated with DPPH. The highest correlation coefficient (*r*) was found between DPPH and TFC with a value of 0.96, while that of DPPH and TPC was found to be 0.84.

Table 5. Correlation between DPPH, TPC and TFC

	DPPH
Total phenolic content	0.84
Total flavonoid content	0.96

Discussion

CIE colour

Colour is important and is among the quality indicator of the roasting process. As the roasting increases, the peanut colour darkens as confirmed by a decrease in the L* value which may be due to browning substances. Peanuts roasted at 140 °C for 5, 10, and 15 min and at 150 °C for 15 and 20 min did not differ significantly ($p>0.05$). This showed that at a particular temperature, the proximate time did not influence the colour significantly and this trend is in line with many findings which show that L* values decrease over time at the same temperature.

The a* value, which measured the redness of the kernel, presents ($p<0.05$) a difference in the roasting conditions, but at certain times, for example, at the 5th and 10th min at 130 °C, a* was not significantly different ($p>0.05$). Moreover, in the same manner, at 150 °C a similar trend was reported at certain times that were close to each other. The b* values showed a similar trend with significant differences in peanuts roasted at 130 °C for 15 and 20 min, and at 140 °C for 15 and 20 min. The b* value showed an increase in peanuts roasted at 150 °C for 5 and 10 min. However, a decrease at 20 min. A similar result was found in the b* values of roasted chickpeas which may be attributed to the burning of the sample (Jogihalli et al., 2017).

However, in the present study, L* colour values contradicted the reported value of McNeill and Sanders (2008) who reported a ranged value of 49.1 to 50.9 for peanut and peanut paste roasted at 205+3 °C

for 30 to 31.5 min. It has been reported that an increase in the roasting conditions resulted in the formation of browning reactions of products and influenced colour development (Jittrepotch et al, 2010). Lightness was also affected during the storage of food. Jittrepotch et al. (2010) found that peanut colour decreases with an increase in microwave time. However, the values were higher than our reported finding. Moreover, Yeh et al. (2002) reported that the L* value in peanut spread was higher compared to our finding and it may also be because the kernel pellicle was not removed in our present study. In addition to that, the applied roasting conditions might contribute to the difference in the colour values. However, L* values of whole peanuts roasted at 130 °C for 5 to 20 min correspond to the value of blanched peanuts with microwave times of 5.5 and 6.5, as reported by Jittrepotch et al (2010).

Sensory attributes

Colour

The temperature and time of roasting significantly affect the colour of the food sample and this implies that high roasting conditions accelerate the Maillard reaction which improves the colour attribute. Colour of whole peanuts were evaluated using a 9-point hedonic scale and our finding correspond to those reported by Yeh et al. (2002). Riveros et al. (2009) also found that the sensory scores of peanuts made from high oleic and normal oleic peanut paste are, respectively, 6.91±0.42 and 7.12±0.52. Their finding is in line with our present study.

Flavour

Flavour is a quality attribute produced during roasting. Several factors affect flavour which include environment and maturity (McNeill and Sanders, 2008). Pyrazine is the main source of the flavour provided by the roasted peanut formed upon roasting (Williams et al., 2006). According to the authors, peanut flavour is evaluated using different terms. The present finding agrees with the study of Riveros et al. (2009) who found that the flavour attribute of peanut paste received a score of 6.51 ± 0.35 and 6.71±0.25, respectively. This showed that further processing of the peanut could retain the flavour of the roasted peanut driven during roasting. In the same manner, our finding agreed with the results of the study by Rajkumar et al. (2012), except the low flavour scores obtained for peanuts roasted at 130°C for 5min and those roasted at 150°C for 15 and 20 min due to under- and over roasting. Moreover, Grosso and Resurreccion (2002) reported the flavour of cracker-coated peanuts and roasted peanuts as 6.23 ± 1.94 and 6.44 ± 1.70 respectively at the 0 day, which coincides with our reported values at all roasting conditions.

Crunchiness

Crunchiness and hardness are the quality attributes of roasted food products. It determines the sound released when the roasted materials are broken by molar teeth (Mestrallet et al., 2004). Crunchiness is among the texture attributes that are used to determine the quality and grade of the roasted products (Nepote et al., 2008). San Juan et al. (2007) revealed a crunchiness liking score of 6.8-7.4 in peanuts brittle packed and stored at 4 °C for 158 days and agreed with our reported value except the peanuts roasted at 130°C for 5 min which received low scores.

Overall acceptability

Overall acceptability was used to assess the overall quality of roasted peanuts. The present finding disagreed with those of Nepote et al. (2006). The difference may be attributed to the type of judges or the skin which was not removed in our study contributing to the overall acceptance of the product. Comparable results were also reported by Rajkumar et al. (2012). Furthermore, according to Grosso and Resurreccion (2002), the overall acceptability is in line with our findings.

TPC

Polyphenols are secondary metabolites which contribute to the antioxidant activity of foods. Recently, polyphenols research received much attention due to their impact attributed to the treatment and management of cardiovascular diseases (Zzaman and Yang, 2014). It has been reported that most of the bioactive compounds are predominantly found in their skin which serves as a protection to the internal structure. Therefore, the outer skin and outer part of the plant contain higher polyphenolic compounds. Previous findings revealed that the peels of most plants contain higher phenolic compounds than the internal structure. Hence, when the skin is removed, most bioactive compounds are lost (Bolling et al., 2010). The highest TPC was found in peanuts roasted at 140 °C for 10 min, which was significantly (p<0.05) higher than at the other roasting conditions. Roasting conditions and other processing methods were found to affect the phenolic compounds. However, it is inconsistent with the research by Bolling et al. (2010). De Camargo et al. (2012) noted a noticeable increase in TPC of peanut skin treated with irradiation. Wani et

al. (2016) observed a similar trend in flour from arrowhead; the authors noted the highest TPC increment in microwave roasted samples when compared to those roasted in pan. Jeong et al. (2004) noted that roasting increased the concentration of TPC of defatted sesame meal extract. Some researchers showed that processing such as roasting increased the polyphenolic content, which may be due to the formation of antioxidative products through the Maillard reaction. However, Bolling et al. (2010) reported that roasting decreased the TPC but not total flavonoids. Moreover, physicochemical processes such as ripening affect the total phenolic content. Adedayo et al. (2010) found that total phenolic content increases significantly during the ripening process in pepper fruit (*Dennettia tripetala*), but this does not refer to total flavonoids. However, Bolling et al. (2010) reported a 26% decrease in TPC than in the unroasted almond skins, which contradicts our finding. Garrido et al. (2008) revealed that total phenolics from almond skin processed by blanching, drying, and roasting. John and Shahidi (2010) also reported the TPC of whole Brazil nut, which was, however, lower than the values of TPC of our present study. Another study conducted by Kosińska and Karamać (2006) reported that the TPC of a roasted sesame seed, pumpkin seed, soya beans, and wheat germs was lower than the value reported in our present study except for roasted sunflower seeds. The variation might probably be due to the different roasting conditions. The increase in total phenolics contradicted the findings of Lemos et al. (2012) who found a decrease of phenolic compounds in roasted barunut with and without peel when compared to the values of unroasted barunuts. The decrease in polyphenol content may be due to the fact that some of the phenolic compounds are susceptible to heat and therefore degrade (Chandrasekara et al., 2012). Win et al. (2011) reported that peanut skin had the highest TPC followed by hulls, while roasted and unroasted kernels had the lowest. The value reported, however, was lower than the value reported in our study except for peanut skin, which shows that the skin contributes significantly to the phenolic compounds in the whole peanut. Therefore, utilizing whole peanuts improves the dietary antioxidants which will help to address the degenerative diseases associated with free radicals. Ali et al. (2016) reported the TPC of Bangladeshi peanut lower when compared to our present finding.

TFC

Flavonoids of roasted and unroasted peanut kernels varied. The highest TFC is seen in peanuts roasted at 150 °C for 5 min. It is clearly shown that roasting temperature can influence the flavonoid content. A similar trend was noted by Hassan (2013a). Moreover, the finding of Segev et al. (2012) indicated that processing methods such as frying, baking, and roasting of coloured chickpea seeds increased the TFC significantly. The trend is similar to our present study. Microwave roasting of chickpeas at high power increased the TFC (Jogihalli et al., 2017). TFC of both unroasted and roasted peanuts is higher than in some seeds. For example, the values of flavonoids of different types of millet, as reported by Upadhyay et al. (2013), were lower than in our present study except for methanolic extract of bajra species, where the values were similar to our unroasted peanut, TFC of peanuts (Bangladeshi cultivar) was found to reduce after the microwave roasting process (Ali et al., 2016).

DPPH

Free radicals are reactive oxygen species that cause oxidative damage to macromolecules (Abdulrahman et al., 2021). DPPH determine the scavenging activity of antioxidative compounds (John and Shahidi, 2010; Abdulrahman et al., 2019). Nuts including peanuts contribute to the dietary intake of antioxidants. Several in vitro antioxidant assays have been developed (Feyisayo and Oluokun, 2013). DPPH activity was evaluated. Whole peanuts roasted at 150 °C for 5 min exhibited increased scavenging activity. The roasting of arrowhead flour using a microwave resulted in a significant increase in DPPH scavenging activity (Wani et al., 2016). A similar trend in the antioxidant activity of macadamia nuts roasted at 170.7 °C was reported (Schlörmann et al., 2015). A similar trend of roasting on the antioxidant capacity of chickpeas was reported (Jogihalli et al., 2017). Lipophilic antioxidant capacity in pistachios and walnuts decreased after roasting (Schlörmann et al., 2015). The IC_{50} value was found to increase in all roasting conditions. In the same vein, Hassan (2013b) reported an increase in the antioxidant of sesame meal measured by hydrogen scavenging activity as a result of oven roasting. A significant increase in DPPH radical scavenging activity was observed in almonds roasted at 150, 180 and 200 °C for 5 min. was lower than in our study. In the research by Lin et al. (2016), the sample was defatted and extracted fat-soluble vitamins which also act as antioxidants.

Correlation between DPPH, TPC and TFC

Bioactive compounds are responsible for all biological activities such as antioxidant property. In the present study, TFC highly correlated with DPPH, unlike TPC.

This agreed with the findings of Hu et al. (2016) who reported the correlation coefficient (r = 0.984) for TFC and DPPH. Piluzza and Bullitta (2011) also reported a similar trend. Interestingly, the correlation coefficient (r) was found to be similar to our present study.

Conclusions

Roasting significantly affected various quality attributes which reflect the final product acceptance. Peanuts roasted at 130, 140, and 150 °C for 15, 10, and 5 min, were preferred. Overall acceptability results showed that the skin may improve the flavour as a result of roasting which enhances the quality and hence is accepted by judges. The findings suggest that instead of removing the pellicle or skin, the whole peanut can be processed for better nutritional and phytochemical content which has been shown to reduce chronic diseases and will improve the production economy and waste disposal. TPC, TFC, and DPPH were increased in the samples roasted at 130, 140, and 150 °C for 15, 10, and 5 min, respectively. Peanuts roasted at 140 °C for 10 min had the best radical scavenging capacity, followed by peanuts roasted at 150 °C for 5 min and 130 °C for 15 min.

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