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Evaluation of Antioxidant Activity and Bioactive Compounds on Domestic Cooking Method

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A B S T R A C T

Nuts and oil seeds are extremely nutrient-dense foods. They provide generous amounts of calories, fats, complex carbohydrates, protein, vitamins, minerals and fiber. Roasting is the main thermal processing technique used for nuts and oil seeds in order to enhance their sensory properties and value addition. The present research studied the effect of domestic cooking methods on antioxidant activity and bioactive compounds in ground nut and sesame seeds. The total phenolic content was increased to about 21.7% and 25.8% in sesame seed and ground nut respectively on roasting. The flavonoid content of raw extracts of groundnuts was 115.57mg RE/100g and sesame was 126.78mgRE/100g, while in roasting the total flavonoid content of groundnut was found 145.3mgRE/100g and sesame was 154.27meRE/100g. The antioxidant activity levels by FRAP and DPPHSA was increased on roasting in both ground nut and sesame seeds at 1% significant difference level except ground nut in DPPH scavenging assay.

Introduction

Nuts and oil seeds are extremely nutrient-dense foods. They provide generous amounts of calories, fats, complex carbohydrates, protein, vitamins, minerals and fiber.

Moreover, nuts contain certain bioactive compounds which act as antioxidants such as a variety of phenolic compounds and flavonoids, free radical scavengers, and metal chelates that play a role in the reduction of the risk for the development of chronic diseases (Blomhoff *et al.,* 2006). Several recent observations suggest that the flavonoids present in nuts act in synergy with vitamins C and E and have interesting biological effects that may be related to a favorable effect on cardiovascular diseases (Mukuddem-Petersen *et al.,* 2005).

Nuts and oilseeds consumed in small quantities are precious to our diet for health reasons. The consumption of nuts (raw or processed) has increased over the last decades due to their availability at reasonable prices and the rise in the nutritional health awareness (O'Neil *et al.,* 2010). The consumption of nuts has been shown to be beneficial to health. This is primarily due to their desirable lipid profile, which is higher in unsaturated fatty acids than in saturated fatty acids.

Sesame (*Sesamum indicum* L.) is one of the important oilseeds used in human foods in different forms. It has high protein content, providing an excellent nutritional value and a great resistance to oxidative deterioration of sesame seed oil and seeds results in a great high oxidative stability during storage, processing or heating. The stability in sesame seed oils is due to their richness in various endogenous compounds like lignans, tocopherols and phenolic compounds. In particular, sesame seeds are known to exhibit various health beneficial properties, including hypocholesterolaemic, hepatoprotective, and antimutagenic effects (Chen *et al.,* 2005), (Lazarou *et al.,* 2007), (Yokota *et al.,* 2007). Sesame spots, cakes, and seeds exhibited high activities in reducing power and radical scavenging methods as well as protection against oxidative deterioration, sesame seeds provides highly stable oil and nutritious protein and meals, used in sweetmeats and confectionery foods, and have varieties of medicinal properties (Kapoor, 2001).

Peanuts though classified as a legume have high lipid content that is rich in monounsaturated fatty acids and do not contain cholesterol (Higgs, 2003). Epidemiological and intervention studies have shown that the frequent consumption of peanuts promotes cardiovascular health by lowering serum low density lipoprotein (LDL)-cholesterol levels and reduces the risk of development of type II diabetes (Hu *et al.,* 1998; Fraser *et al.,* 1992; Jiang *et al.,* 2002; Alper and Mattes, 2002; Alper and Mattes, 2003). It has also been shown to promote weight management when consumed as part of a moderate fat diet as a result of its satiating effect (Higgs, 2005). In addition to nutrient composition, peanuts also contain certain bioactive compounds that play a role in the reduction of the risk for the development of chronic diseases such as cancer, diabetes, and coronary heart diseases (Higgs, 2003), (Messina and Barnes, 1991), (Hu and Stampfer, 1991).

Roasting is the main thermal processing technique used for nuts and oil seeds in order to enhance their sensory properties and value addition (Ingolf U. Grün *et al.,* 2001), (Stintzing *et al.,* 2006), (Rizki *et al.,* 2015). There are several commercial products, with nuts and oil seeds are available in the market that contains roasted and fried nuts. Roasting and frying not only can change the noticeable rawness of nuts but also can subsequently have chemical changes on nuts. Therefore it is important to study the chemical and bioactive compounds changes that take place due to commonly used thermal processing techniques. There is also lack of scientific information on the differences in their bioactive compounds on thermal processing techniques in nuts and oil seeds. In view of this the present research work on bioactive compounds viz. total flavonoids, phenolic content and antioxidant properties in relation to domestic cooking method, roasting in frequently used nuts and oils seeds was taken up. Roasted nuts and oil seeds which were experimented with in this study were obtained from local markets of study place.

Materials and Methods

The sesame seeds and ground nuts were procured from local markets of Hyderabad, Telangana state. The sesame seeds and ground nuts were roasted in a tawa till the pleasant aroma comes and changed the colour to slight brownish.

Five hundred grams of the seeds were spread in a preheated tawa and dry roasted with periodic shaking for even roasting. The roasted nuts were then cooled and kept ready for extraction of analysis samples for total flavonoids, total phenols and antioxidant activity levels.

80% methanol acidified with 6N hydrochloric acid (pH 2.0) was used for extraction of the vegetables. Total phenolic content (Singleton *et al.*, 1999), flavonoids (Zhishen *et al.*, 1999), and antioxidant activity properties, (1-diphenyl-2-picrylhydrazyl (DPPH) radical-Scavenging Activity (Tadhani *et al.*, 2007), and Ferric reducing antioxidant power (FRAP), (Benzie and Strain, 1999; Benzie and Strain, 1999) were estimated in the extracts using standard analysis procedures.

Results and Discussion

The bioactive compounds of nuts such as the antioxidants capacity, phenol and flavonoids are associated with numerous health benefits and are affected by heat treatments. Therefore, this study is aimed to investigate the effects of roasting on the content of bioactive compounds.

Total phenol content

The total phenol content of raw extract of ground nut and sesame seed was 115.57 mg GAE/100g and 126.78 mg GAE/100g respectively. The total phenolic content was increased to about 21.7% and 25.8% in sesame seed and ground nut respectively. The groundnut and sesame seed contained about 145.3 mg GAE/100g and 154.27 mg GAE/100g of TPC on roasting process. Hence the results demonstrated the commonly used thermal processing method, roasting had a remarkable effect on the levels of TPC in ground nuts and sesame seeds (Table 1). The similar result was also reported by (Win *et al.*, 2011) for oven-roasted peanut extracts. (Pandey and Awasthi, 2015) also mentioned that roasting increased the total phenolic content in fenugreek seeds. The roasting process might likely increase the TPC through partially destroy of the cell structure, resulting in the release of some bound phenolic compounds, which could then become more extractable in solvents (Zou *et al.*, 2015). In addition, the increase in the TPC of may also be linked to the development of maillard reaction products during the roasting process (Win *et al.*, 2011). Generally, the thermal treatment applied to foods of plant origin by heating or roasting cause's evaporation of intracellular water, triggering chemical reactions that can change the lignocellulosic structure and promotes protein denaturation, which may result in a greater availability of plant phenolic compounds in the matrix. Therefore, a thermal process can affect both the nutritional and bioactive characteristics of foods. Polyphenols occur in nature in free or bound forms, thus some processing methods such as boiling or heating have been shown to increase the polyphenolic content of foods. In the present study ssignificant difference at 1% level was observed in the total phenolic compounds of ground nuts while sesame showed no significant difference between raw and roasting. However between raw ground nuts and sesame seed negative 1% level significant difference was found and in roasting 1% level significant difference was found between groundnuts and sesame.

Table 2 showed that the roasting process had a significant effect on the flavonoid content in selected nuts and oil seeds. The flavonoid content of raw extracts of groundnuts and sesame was 115.57mg and 126.78mg RE/100g, and the content increased to 145.3mg and 154.27me RE/100g in roasting process. The significant increase in total flavonoid content could be explained with breaking of binds in the structure of SDG lignan complex and also other polyphenolic compounds in selected nuts and oil seeds with heat treatment at roasting process. Also, the increase in phenolics could be explained with breaking of the interactions between flavonoid compounds and cell wall polysaccharides such as cellulose, hemicellulose and pectin because of the temperature during the roasting process.

In a study by Catherine *et al.,* (2011) mentioned that roasting did not cause any significant loss on the flavonoid content of legumes and oil seed but interestingly loss of significant level of flavonoids noticed in the groundnut, field bean and pumpkin seeds on soaking and cooking with water and noted that this could be attributed to water-soluble flavonoids that were leached into soaking and cooking water as well as degradation of flavonoid compounds at elevated temperature during cooking. In another study by Yvonne Chukwumah *et al.,* (2007) observed that roasting processing did not affect the total flavonoid content of the peanuts. However, this was not in the case for the total polyphenols.

Total flavonoid content

In the study a significance difference of 1% was found in total flavonoid content of both the samples between raw and roasting, whereas negative 1% level of significant difference was found between raw groundnuts and sesame and 1% level of significant difference was found

The total AOA content of raw extracts of groundnuts and sesame in FRAP method was 105.49mg TE/100g and 163.88mgRE/100g, while in roasting it was 142.8mgRE/100g in groundnut and 100.46meRE/100g in sesame seeds. There is a significance difference at 1% was found between raw and roasting of ground nut samples, whereas negative 1% level of significant difference in sesame seeds (Table 3). However, negative 1% level of significant difference was found between raw groundnuts and sesame and no significant difference was found between roasted groundnuts and roasted sesame seeds.

Total antioxidant activity

According to Acar *et al.,* (2009), roasting nuts may destroy some bioactive compounds, but it can also form antioxidant compounds through the Maillard reaction.

However, the total antioxidants capacity after roasting is the result of the thermal degradation of naturally occurring antioxidant compounds and the formation of new Maillard reaction products having antioxidant activity. Chandrasekara and Shahidi (2011) suggested that roasting cashews at high temperature short time enhances effectively its antioxidant activity which is shown to be true as well in this study.

Table.1 Total Phenolic content of selected nuts and oil seeds (mg GAE/100 g)

S. No	Food	Raw	Roasted	%Change	f-value/t-value
1	Groundnut	115.57(±1.45)	145.3(±2.65)	25.72467	169.9**
2	Sesame	126.78(±1.61)	154.27(±1.33)	21.68283	-22.7NS
	t- value	-8.93**	5.23**		

** Significant at 1% level

Table.2 Total Flavonoids in content in selected nuts and oil seeds (mg RE/100g)

S. No	Food	Raw	Roasted	%Change	f-value/t-value
1	Groundnut	115.57(±1.45)	145.3(±2.65)	35.36828	417**
2	Sesame	126.78(±1.61)	154.27(±1.33)	-38.699	34.7**
	t-value	-41.05**	5.23**		

** Significant at 1% level

Table.3 Total AOA of selected nuts and oil seeds by FRAP method (mg TE/100g)

S. No	Food	Raw	roasted	%Change	f-value / t-value
1	Groundnut	105.49±1.15	142.8±2.26	18.31671	230.7**
2	Sesame	163.88±2.18	100.46±2.29	5.520574	-7.24**
	t-value	-16.55**	31.8 NS		

** Significant at 1% level

Table.4 Total AOA of Nuts and Oilseeds by DPPH method (mg TE/100g)

S. No	FOOD	Control	R1(Roasted)	%Change	f-value
1	Groundnut	458.88(±1.98)	510.87 (±1.72)	11.32976	-
2	Sesame	522.5(±3.15)	547.23(±2.24)	4.733014	44832**
	t-value	-29.62**	-22.3**		

** Significant at 1% level

In the DPPH scavenging assay, the antioxidant activity was measured by the decrease in absorbance as the DPPH radical received an electron or hydrogen radical from an antioxidant compound to become a stable diamagnetic molecule (Juntachote and Berghofer, 2005). This activity was revealed to increase with roasting process in both ground nut and sesame seeds in the present study (Table 4). The results were in accordance a study where it was revealed that the roasting treatment causes a clear increase in antioxidant activity (Rizki *et al.*, 2015). This activity gradually increased during roasting reaching to an apparent maximum within 120 min, and there was a decrease in the antioxidant activity of samples after roasting time of 180 min. The other study (Abbas Ali *et al.*, 2016) demonstrated that the extracts of roasted samples of peanuts at all concentrations showed significantly ($p < 0.05$) higher DPPH radical-scavenging activity than unroasted ones. The activity increased significantly ($p < 0.05$) from 70.26% in the raw sample to 74.63, 78.05 and 80.16% in the samples roasted for 2.5, 5 and 7.5 min, respectively

In the present study the total AOA content of raw extracts of groundnuts in DPPH method was 458.88mg TE/100g and sesame was 510.8mg RE/100g, while in roasting the total AOA content of groundnut was found to be 522.5mg RE/100g and sesame was 547.23me RE/100g. Whereas 1% level of significant difference was found in raw and roasted sesame. However, negative 1% level of significant difference was found between raw groundnuts and sesame and roasted groundnuts and sesame seeds.

An increase in bioactive compounds is believed to give the plausible taste in roasted and fried nuts rather than the raw one. Raw nuts are known to have a tart-like taste but once roasted or fried this specific taste can disappear. One of the explanations stems from the increase in flavonoids phenols and antioxidant activities.

The antioxidant activity of nuts and oilseeds are owing to the essential nutrients that enhance and contribute to health benefits. The bioactive compounds and antioxidant activity of foods is affected by thermal treatments either in positive or negative mode. In the present study the total phenolic, flavonoid content and antioxidant activity of ground nut and sesame seed extracts was significantly affected by domestic roasting method. The

improvement result might be partially attributed to the formation of Maillard reaction products. Therefore, the consumption of groundnut and sesame seed and its products offers a good source of important bioactive compounds in spite of high content of calories and is beneficial to human health and can be best sources to use an alternative to non-nutrient high-calories food used.

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Conflict of Interest: Nil

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