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Improving the antioxidant properties of sesame oil through the addition of natural bioactive compounds

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Abstract

Sesame (*Sesamum indicum* L.) is a valuable oilseed crop that contains several nutritious bioactive compounds. Sesame seeds have a high oil content (50-60%). They are rich in high quality unsaturated fatty acids. Sesame seeds contain phenolic compounds such as sesamin and sesamolin, which have been reported to be valuable compounds for human health. Sesame oil is obtained by cold pressing. Sesame oil has never been used as an edible oil; it has been and continues to be used as a condiment in traditional dishes in Asian countries. The purpose of this research was to determine the quality of the flavoured sesame oil obtained by the addition of vegetable spices to sesame oil (basil - *Ocimum basilicum*, garlic - *Allium sativum*, cumin - *Cuminum cyminum* and cinnamon - *Cinnamomum zeylanicum*). The addition of garlic, cumin, cinnamon or basil to sesame oil can provide additional benefits. Garlic is well known for its anti-microbial and anti-oxidant properties. Cumin can help with digestion and may also have anti-inflammatory properties. Cinnamon may have antimicrobial and antioxidant properties and may help control blood sugar levels. Basil is known to have anti-inflammatory, antioxidant and anti-microbial properties. The highest amount of total polyphenols was found in the oil samples flavoured with cinnamon. The highest antioxidant capacity was found in sesame oil samples flavoured with garlic. All these spices improve the quality of the oil through the addition of natural bioactive compounds.

Key words: sesame oil cold pressed, natural bioactive compounds.

1. Introduction

The term "spices" and "herbs" are used to describe plant-derived substances that are used to enhance the flavour of any dish; that is used as food due to its aromatic properties. Spices can be derived from a variety of plant parts: roots, rhizomes, stems, leaves, bark, flowers, fruits and seeds [1]. Spices can be used in various forms, including fresh or dried, whole or ground. A dried spice has the longest shelf life. However, a fresh spice is usually more flavorful than its dried form [2].

Sesame oil is nutritionally rich in antioxidants and specific bioactive compounds such as lignans (sesamin, sesamolin, phytosterols, tocopherols, etc.). Its high antioxidant activity makes it a unique and very high quality functional food. Sesame oil may be considered as edible oil containing a high level of bioactive compounds with nutraceutical properties. Sesame oil is one of the healthiest oils on the market, containing 46.26% linoleic acid and 38.84% oleic acid, which are high levels of unsaturated fatty acids [3]. The phenolic composition and potentially beneficial properties of sesame seed oil make it a product with positive health implications [4]. Spices are primarily used as food flavoring. It is noteworthy that a significant number of spices were used in herbal medicine [2].

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It has been reported that approximately 25% of drugs currently in clinical use are derived from natural plant products due to antioxidant properties [5]. The consumption of sesame oil assist in the treatment of a number of inflammatory diseases (osteoarthritis), cardiovascular, neurodegenerative, diabetic eye disease, lung and liver diseases skin disease and Alzheimer's disease [3].

The antioxidant activity of plant extracts is of particular interest. They have the potential to replace synthetic antioxidants used in food [1]. Nowadays, there has been an increase in interest in the use in food technology for producing food with added value [6].

It was found that the addition of natural antioxidant compounds in food products has advantage of enhancing their shelf life [7].

The aim of our study was to obtain and characterise the following four sesame oils enriched with natural antioxidant compounds derived from spices and aromatic plants: basil, garlic, cumin and cinnamon..

2. Material and methods

2.1. Materials

The cold-pressed sesame oil was purchased from Timisoara supermarket, as were the dried spices (cumin, Cuminum cyminum, and cinnamon, Cinnamomum zeylanicum). The basil fresh leaves - Ocimum basilicum and garlic - Allium sativum were acquired from a local shopping square.

The bioactive compounds present in fresh aromatic plants (basil and garlic) and dried aromatic plants (cumin and cinnamon) were investigated, as were the bioactive compounds present in flavoured sesame oil.

2.2. Chemical analysis

The aromatic plants (1g) and the cold - pressed sesame oil (10 g) are placed in four dark bottles. During 21 days of maceration at room temperature (20^0C), the samples were stirred periodically. After this time, the oil samples were filtered and chemically analysed. A control sesame oil (C) and an oil sample with basil (FSO1), garlic (FSO2), cumin (FSO3) and cinnamon (FSO4) were prepared for analysis.

Flavored sesame oils were analyzed in terms of total antioxidant capacity (TAC) by FRAP assay [8] expreses in mM Fe^{+2}/L, total polyphenolic compounds content (TP) by Folin-Ciocalteau method [9, 10] in a 70% ethanol, calculated in mM gallic acid equivalents (GAE)/L and vitamin C by titration with 2,6-dichlorophenolindophenol sodium [10]. For TAC and TP determination, the samples were read at λ = 593 nm respectivelly λ = 725 nm using Spectrophotometer UV-VIS SPECORD 205 by Analytik Jena. The gallic acid was used as a standard for TP. The ascorbic acid content was calculated on the basis of standard curve and was expressed as mg ascorbic acid/g d.w. All determinations were made in triplicate.

2.3.Statistical Analysis

Simple linear regression analysis was used to obtain some correlations between the content of bioactive compounds in FSO samples. Pearson correlation was conducted using Microsoft Office Excel 2011 for Windows.

3. Results and Discussion

Foods of plant origin are an excellent source of natural substances with antioxidant effects [11]. Many studies [6, 12] have confirmed the potency of *Ocimum basilicum* L. as a natural antioxidant, due to the abundance of polyphenolic compounds it contains, especially the rosmarinic acid. The content of total polyphenol in fresh and dried spices was found to vary considerably. The highest quantity was identified in cinnamon, followed by garlic and basil, while the lowest quantity was observed in cumin. However, vitamin C increased in aromatic plants from cumin, to garlic, to basil and to cinnamon (Table 1). The cumin seeds have good antioxidant potential and can be used to produce novel natural antioxidants as well as flavours that are used in various flavours that can be used in various food products [1].

It is known that cold-pressed sesame oil is a valuable source of nutrients, including essential fatty acids, vitamins (especially vitamin E), minerals, antioxidants and phytosterols [3]. The vitamin C content was found to be below the detection limit in the sesame oil sample.

Aromatic plants are an important source of antioxidants which are transferred to sesame oil, enriching it with bioactive compounds. The experimental results are presented in Table 2.

Table 1. The bioactive compounds in aromatic plants

Antioxidant compounds	basil	garlic	cumin	cinnamon
TAC (mM Fe^{2+}/g d.w.)	1230	986	1444	882
TP (mg GAE/g d.w.)	0.203	0.310	0.180	0.510
Vitamin C (mg/100 g d.w.)	16	18	21	3.8

Table 2. The bioactive compounds in flavoured sesame oil

Antioxidant compounds	C	FSO1	FSO2	FSO3	FSO4
AC (mM Fe^{2+}/g)	500	850	1244	810	1100
TP (mg GAE/g)	105.9	112.2	114.9	103.3	120.7
Vitamin C (mg/100 g)	-	14.8	16.8	20.2	2.5

Figure 1 shows that there is a positive and very low correlation existed between total antioxidant capacity, total polyphenolic compounds content, Vitamin C and flavoured sesame oil samples (the coefficient of determination R^2= 0.4091, R^2= 0.2195 and R^2 = 0.0322) revealing that all these spices improve the quality of the oil through the addition of natural bioactive compounds.

A Pearson correlation was found between the antioxidant compounds of the spices, SO and FSO (Tables 3-6).

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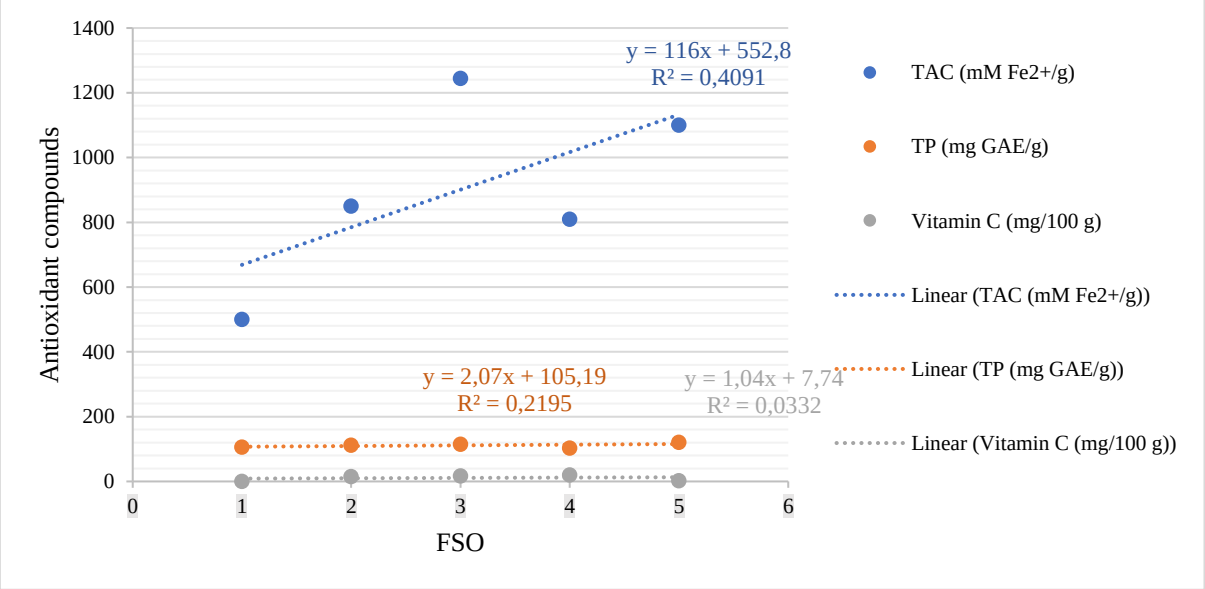

Figure 1. Simple linear regression analysis between antioxidant compounds

Table 3. The Pearson correlation among antioxidant compounds of basil, sesame oil and flavoured sesame oil

	TAC	TP	AA
TAC	1		
TP	0.977287307	1	
AA	0.995443144	0.995443	1

Table 4. The Pearson correlation among antioxidant compounds of garlic, sesame oil and flavoured sesame oil

	TAC	TP	AA
TAC	1		
TP	0.976326782	1	
AA	0.99151567	0.99616	1

Table 5. The Pearson correlation among antioxidant compounds of cumin, sesame oil and flavoured sesame oil

	TAC	TP	AA
TAC	1		
TP	0.977636622	1	
AA	0.994246305	0.994539	1

Table 6. The Pearson correlation among antioxidant compounds of cinnamon, sesame oil and flavoured sesame oil

	TAC	TP	AA
TAC	1		
TP	0.976398088	1	
AA	0.993667331	0.993667	1

Table 7. The Pearson correlation among bioactive compounds of all flavoured sesame oil samples

	TAC	TP	Vitamin C
TAC	1		
TP	0.742844	1	
Vitamin C	0.355227	-0.27645	1

Table 7 shows the statistical analysis results. A moderate negative correlation was observed between the total phenol (TP) content and the vitamin C content of all flavoured sesame oils (r = - 0.2764). A high correlation was observed between TAC and TP (r = 0.742), indicating a strong relationship between these two antioxidant compounds in FSO. TP had an moderate correlation (r = 0.355) [13] with Vitamin C from all assortments of FSO; it confirm the contribution of aromatic plants about each food product

4. Conclusion

The total polyphenol content was found to be highest in samples of oil flavoured with cinnamon. The highest antioxidant capacity was identified in sesame oil samples that were flavoured with garlic. We can say that the bioactive compounds present in different assortments of flavoured sesame oil may not be attributed to a single antioxidant compound, but rather to the involvement of all phytochemicals compounds from food products. The addition of these spices improves the quality of the oil by the contribution of natural bioactive compounds.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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