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Influence of Green Cumin Oil on the Peroxide Value of Reused Sunflower Oil

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Abstract:

This manuscript was designed to determine the influence of extracted oil of Cuminum Cyminum (green cumin) on the peroxide value of reused edible oil, sunflower oil (main edible oil on Sudan). Green cumin oil was extracted from its mature seeds, season 2017 production, by water-steam distillation process. The chemical profile of cumin oil was detected by using GC-MS. The analysis showed that the main chemical constituents of cumin oil were monoterpens and oxygenated monoterpens. Three samples of fresh and two reused oils (taameia and fish frying oil) were subjected to assess the effect of cumin oil on the reused oil by determination of peroxide value. Peroxide value property was investigated before and after addition of cumin extract. The cumin oil had positive effect on the peroxide value which was decreased it and there was significant difference ($P < 0.05$). The study was attributed the clear impact of extracted cumin oil on the peroxide value mainly due to antioxidant compounds such as monoterpens and oxygenated monoterpens in the cumin oil.

Key words: Cumin, Peroxide, Taameia, Monoterpens, Shendi.

1. INTRODUCTION

Cuminum Cyminum is commonly known as cumin. The word cumin in English is derived from the Latin Cuminum, which itself was derived from Greek 'kyminon' [1]. Cumin is

popularity spread from Latin America to Africa and all over Asia [2]. Cumin seed is generally used as a spicy food in the form of powder for imparting flavor to different food preparations [3]. Spices are generally composed of fiber, carbohydrate, fat, sugar, protein, gum, ash, volatile (essential oils), and other nonvolatile components. All of these components impart each spice's particular flavor, color, nutritional, health, or preservative effects. The essential oils in spices are generally composed of terpenes or terpene derivatives, oxygenated derivatives of hydrocarbons, benzene compounds and nitrogen- or sulfur-containing compounds [4].

Cumin is grown from seed and a hot climate is ideal, but it can be grown in cooler regions if started under glass in spring. Sandy soil is most excellent; when the seedlings have hardened, transplant carefully to a sunny aspect, planting out 15 cm apart. The plants bloom in June and July. The seeds are normally ready four months after planting. Cut the plants when the seeds turn to brown, thresh and dry [5]. The major constraints facing the production of cumin worldwide are losses caused by diseases, insects, and weeds [6]. In Sudan, cumin spread up the Nile valley where it continues to be sown by stallholders in the winter season to provide flavoring and other parts of the country. The production is between 0.9 – 1.4 tons in 2013 – 2014 according to ministry of agricultural statistic report, 2014. In the Sudan, Despite the relative importance of this medicinal plant in crop rotation, it has not adequately studied and there is no much information on potential yield of the current cultivated plant worldwide [7].

Figure (1): Seeds of green cumin

The main physiochemical characteristics of green cumin are; moisture content: 8%, PH: 7.3, total ash: 7.5, acid insoluble ash: 18%, alcohol soluble extractive: 6.58%, water soluble extractive: 138% and ether soluble extractive: 11.44 ± 0.20 and 12.36 ± 0.23% in the wet and dry fruits. Physical properties of the essential oil of cumin seeds: extraction percentage; 2.3-5.7 %, color: colorless or pale yellow, refractive index (20 ^{o}C): 1.47-1.50 and density (20 ^{o}C): 0.90 - 0.94 [8]. The chief components of the characteristic aroma of unheated whole seeds are *p*-menthen-7al and cuminaldehyde in combination with other related aldehydes [9].

Cumin had some reputation as a drug but its chief medicinal use now days in veterinary medicine. This spice is also used as a homeopathic treatment for a variety of conditions. Due to its numerous medicinal properties, cumin is used as an ingredient in many home remedies and ayurvedic preparations [10]. In traditional herbal medicine cumin was used to treat hoarseness, jaundice, dyspepsia and mixed with other ingredients to treat diarrhea and colic [11]. In America and Africa the cumin is used as an abortive and as an emmenagogue. In Indonesia, it was used in cases of bloody diarrhea and headache (paste is applied to the forehead). It was also taken orally for rheumatic ailments. In India, cumin was used as an abortifacient, for kidney and bladder stones, chronic diarrhea, leprosy and eye disease [12]. In Unani system of medicine, the cumin fruits were used for the treatment of corneal opacities, ulcers and to relieve cough and inflammation [13]. In Sudan, although cumin is a medicinal plant, used in food industries, drinks, cosmetics and soap [14].

The peroxide value gives information about the number of peroxide compounds in the oil and hence of the age and quality of the edible oil. The lower the peroxide numbers the better and/or newer the oil [15]. Depending on the type of oil, its age, storage conditions, etc., peroxide value is good indicators of oil rancidity. The peroxide value is the number that expresses,

in milli alcoholic potassium hydroxide solution prepared by dissolve equivalent of active oxygen [16].

2. OBJECTIVE OF THE STUDY

The present study aims to determine the effect of cumin oil on the peroxide value of reused sunflower oil. To achieve this aim two types of frying oil (taameia and fish) were prepared.

3. Material and Method

3.1. Samples Preparation

Cumin seeds of the crop season 2017 and modern product sample of sunflower oil, were purchased from local Shendi market. Reused oils were prepared after once frying process of taameia and fish on separately fresh sunflower oil.

3.2. Distillation of Cumin Seeds

Water-steam distillation method was used to extract the cumin oil.

3.3. Chemical Profile investigation

Gas chromatography mass spectroscopy (GCMS- QP 2010 plus) equipped with selective detector mass spectrometry was used to determine the chemical profile of extracted green cumin oil.

3.4. Determination of peroxide value (PV)

Principle of reaction

PV is a redox titrimetric determination. The assumption is made that the compounds reacting under the condition of the test are peroxides or similar product of lipid oxidation. Addition of excess potassium iodide reacts with the peroxide, iodine is produce. Through titration process, iodide reacts with standardized sodium thiosulfate using a starch indicator.

$$ROOH + KI \xrightarrow{H^+,\ heat} ROH + KOH + I_2$$

$$I_2 + \text{starch } (\textit{blue}) + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6 + \text{starch } (\textit{colorless})$$

The method

Oil sample (3g) was weighed into a 250 ml brown glass beaker and placed onto the sample rack. 20 ml solvent mixture [ethanol, acetic acid 3:2] and 1 ml concentrated potassium iodide were added then the beaker was closed and kept for 5 minutes. After that 1 ml of starch and 80 ml distilled water were added and the solution was titrated with $Na_2S_2O_3$ (0.001 mol/l) until the end point.

Calculation

$$\text{Peroxide value} = \frac{(S - B) * N * 1000}{W}$$

Where,

S: volume of titrant (ml) for sample.

B: volume of titrant (ml) for blank.

N: normality of $Na_2S_2O_3$ solution.

1000: conversion of units (g/kg).

3.5. Statistical Analysis

The data after collected was analyzed by using SPSS programme. The confidence limit was 95%, the p value was considered to be significant at value of ≤ 0.05.

4. RESULTS

4.1. GC-MS result:

The GC- MS analysis of cumin oil showed that eleven constituents were identified; seven hydrocarbon monoterpens (33.09%) and four oxygenated monoterpens (66.92%). Table 1 represented the results of GC-MS analysis.

Table 1: Main constituents of cumin oil analyzed by gas chromatography

Terpene Type	Constituent	Percentage %
Monoterpens	ß-Pinene	10.72
	γ-Terpinene	15.07
Oxygenated monoterpens	Cumin aldehyde	38.84
	Cumin alcohol	22.65

4.2. Peroxide value

The peroxide value of three samples (fresh, reused oil of taameia and fish) were determined and the results shown in table 2.

Table 2: the peroxide value of pure sample and mixture

Storage period	Peroxide value
Fresh oil sample	7.3
Taameia reused oil	23
Fish reused oil	28

4.3. Reused sunflower oil

To detect the effect of cumin oil on the reused oil, other new samples of three oils one ml of cumin extract were added separately for each oil resulting in three mixtures (fresh mixture, taameia frying mixture and fish frying mixture), then were subjected again to determine their peroxide value, table 3 shown the results after addition of cumin extract.

Table 3: Peroxide value of fresh, reused and mixture oil

Mixture oil	Peroxide value
Mixture of fresh sample oil	2.7
Mixture of taameiaa frying	12.4
Mixture of fish frying	15.4

5. DISCUSSION

Peroxide value of fresh sunflower oil had been increasing after frying process and it was differed according to type of food frying were; 5.3, 11.7 and 28.2 for fresh, taameia and fish frying oil respectively. That might be explained due to the effect of oil boiling and then cooled which result in chemical changes that occur as a result of break-up during boiling and decomposition of food and which thus result in the oxidation process. Sunflower oil is softer oil and more susceptible to oxidation because it contains double bond of unsaturated fatty acids that became aldehyde, ketones and peroxides. After addition of cumin oil to fresh and reused oil of taameia and fish our study showed that there was clear decreased in peroxide value from 7.3 to 2.7, 23.1to 12.4 and from 28.0 to 15.4 for the three mixture respectively with presence of significant difference ($P < 0.05$). That was proved clear influence of cumin oil on the peroxide value which could be explained by the presence of chemical constituents of cumin oil that have antioxidant role which they reacted with formed peroxides that produced in the edible oil due to oxidation process. The major active phytochemicals responsible for the antioxidant activity of plant derivatives are polyphenols, flavonoids and terpenes. Moreover, the essential oils of herbs and spices are widely known for their strong antioxidant in foods. Several studies utilizing herbs, spices, fruits and vegetable extracts, and have shown that addition of these extracts to raw and cooked meat products decreased lipid oxidation [17].

6. CONCLUSION AND RECOMMENDATIONS

Cumin oil has variety antioxidants which were monoterpens and oxygenated terpenes compounds. The study reflected that the cumin oil has perfect impact on the peroxide value of reused sunflower oil. The study mainly was attributed it to number of

antioxidants compounds in the *Cumin Cyminum* oil that will make it good source in preservation of foods and oils against rancidity oxidative. The study recommends further studies and experiments in this field in order to obtaining scientific results act on serve humanity.

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