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CARUM CARVI – ASPECIES OF FOOD INTEREST WITH ANTIMICROBIAL PROPERTIES. A SHORT REVIEW

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Abstract
This paper is a short review of the Carum carvi L as a species of food interest, with many nutritional and functional benefits but also as a plant rich in bioactive compounds with antibacterial and antifungal action. For screening the cumin nutritional value and antimicrobial activity, we used different Databases and research papers.The nutritional richness in organic compounds (especially carbohydrates), vitamins (dominated by vitamin C, folates, niacin, vitamin E) and minerals (especially calcium, phosphorus) are the basis for the use of this plant as a spice in the food industry and in various culinary preparations. Carum carvi L seeds have a high oil content and over 30 chemicals. The most important components are considered carvone and limonene. Caraway oil is a promising antimicrobial agent against pathogenic, phytopathogene and fungal bacterial species, including species which produce mycotoxins and aflatoxins. Cumin is of interest in traditional medicine andalso for food preservatin.

Keywords: antimicrobial activity, antioxidant activity, Carum carvi L., medicinal uses, nutritional analysis

1. INTRODUCTION

Carum carvi L. called popular cumin, part of the *Apiaceae* family is found in the spontaneous flora, but also cultivated as a medicinal and food plant in different countries (fig. 1) in Europe, Asia, North America, South America, and also Africa and Australia (Salehi et al., 2002; https://www.cwrnl.nl/en/CWRnl-1/CWRbyname/Carum-carvi-L.-1.htm). It seems that the plant has its origins in Asia Minor. In Europe it was introduced from the north of the African continent.

Genetic studies developed by Papini et al. (2007) showed that the genus *Carvum*, and especially *C. carvi* L, is polyphyletic.

Currently, the cumin culture occupies a fairly large area, from the temperate zone, in the north to the tropics (by De Carvalho and Da Fonseca, 2006).

It can be found in spontaneous flora (wild cumin), in meadows, in fields, at the edge of forests, but also in culture. Preferred areas are wet meadows and arable land, from the plains to the mountains (Rosooli and Allameh, 2016).

Wild cumin seeds are small compared to cultivated cumin seeds. The varieties are annual and biennial, the latter being preferred by specialists, because there are improved biennial varieties whose seeds have a high content of essential oil (7%) (Morcia et al., 2016). It is one of the spices used as a flavoring and preservative for food.

Herbs and spices have been used since ancient times to fortify foods, as preservatives, flavorings and therapeutic agents.

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Taxonomic classification Kingdom: *Plantae;* Division: *Magnoliophyta*; Class: *Magnoliopsida*; Subclass: *Rosidae;* Order: *Apiales;* Family: *Apiaceae (Umbelifereae)*; Genus: *Carum*; Species: *Carum carvi* L (Agrahari and Singh, 2014; Goyal et al., 2018)

Figure 1. Distribution of Carum carvi L (https://www.cwrnl.nl/en/CWRnl-1/CWRbyname/Carum-carvi-L.-1.htm, wilde-planten.nl, 2015; https://midwestherbaria.org/portal/taxa/index.php?taxon=17994&clid=3511)

The aim of this paper was to emphasize the importance of cumin for food, its antimicrobial properties and its medicinal attributes.
To screen the nutritional, chemical value and antimicrobial activity, we used different Databases (example United States Departament of Agriculture or U.S.D.A., Google Scholar, Springer, PubMed, Science Direct) books and research papers, using keywords related to the chosen topic.

2. PHYTOCHEMISTRY

Studies on cumin oils and extracts have revealed a rich chemical composition. Cumin seeds contain polysaccharides, lignin, fatty acids, triacylglycerols (Laribi et al., 2010; Seidler-Lozykowska, 2010). Many authors determined vitamins, carbohydrates, amino acids, fiber, tannins and mineralsin cumin seeds and roots (El-Sawi et al., 2002; Al-Bataina et al., 2003; Uma et al., 1993).

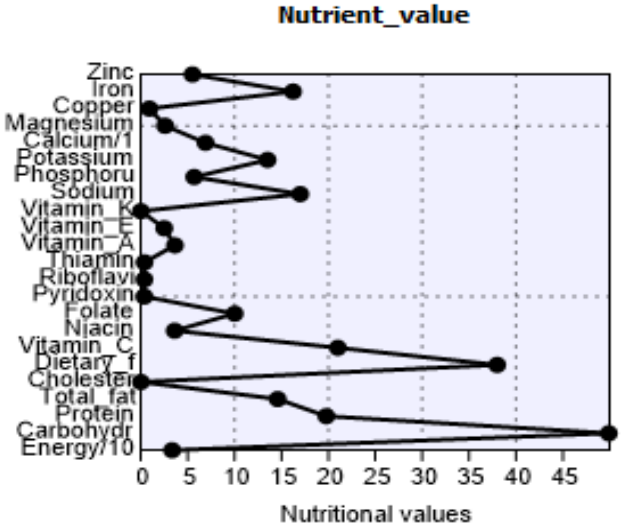

Figure 2. Carum carvi L. nutritional value (/100 g) *(Sources: USDA, 2011; Agrahari and Singh, 2014)*

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According to USDA data (Fig. 2; Fig. 3)) *Carum carvi* L. seeds have a low water content of 9.87 g and a high content of carbohydrates 49.90 g, fiber 38 g, protein 19.77 g, total lipids 14.59 g, calcium 689 mg, sodium 17 mg, iron 16.23 mg, potassium 13.51 mg, vitamin C 21 mg, vitamin A 3.63 mg, vitamin E 2.5 mg, to which are added other nutrients in smaller quantities. The energy is 333 kcal (USDA, 2011, Agrahari and Singh, 2014).

As we can observe the shortest distance is shown by the following nutritional components (fig. 3):

- Cluster 1 formed by 3 smaller clusters:
  - Cluster 1.1 Copper, Cholesterol, Vitamin K, Pyridoxine, Riboflavin, and Thiamin;
  - Cluster 1.2: Vitamin E, Magnesium/100, Energy/100, Niacin, Vitamin A/100;
  - Cluster 1.3: Phosphorus/100, Zinc, Calcium/100, Folate;
- Cluster 2: Protein, Vitamin C, and Total fat, Potassium/100, Sodium and Iron;

Cluster 3: Carbohydrates, Dietary fiber.

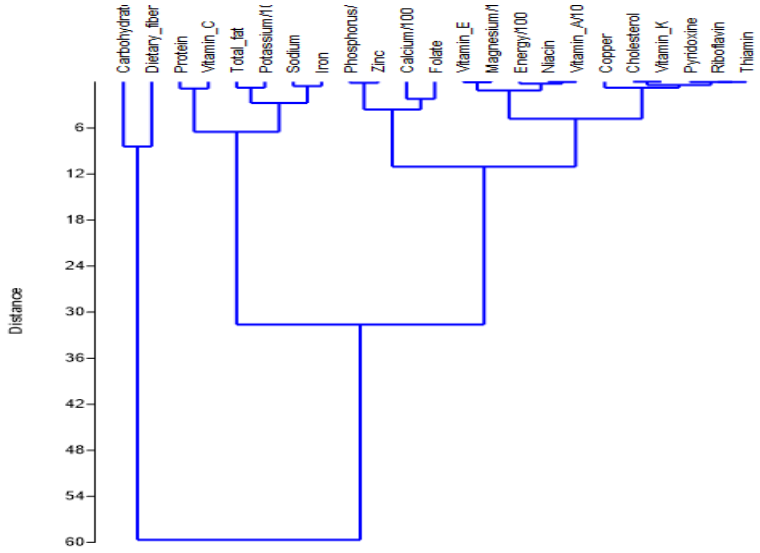

Figure 3 Cluster Analysis of Nutritional Components *(Sources: USDA, 2011; Agrahari and Singh, 2014)*

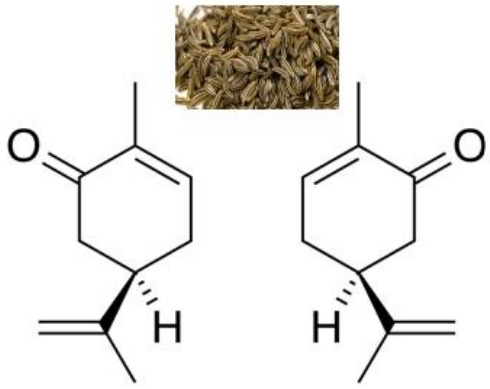

Figure 4. Carvone structure *(Agrahari and Singh, 2014)*

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According to many studies *Carum carvi* L. seeds contain 1–9% essential oils, and over 30 compounds (Arganosa et al., 1998; Sedláková et al., 2003).
It is estimated that the world production of oil extracted from cumin seeds is around 10 t/year (by De Carvalho and Da Fonseca, 2006).
The most important compounds in cumin oils are considered carvone (Fig. 4), limonene, carvacrol, p-cement, γ-terpene, carvenone, linalool and α-pinene (Zheng et al., 1992; De Carvalho C, Da Fonseca, 2006; Johri, 2011). There are studies that show that monoterpenes (carvone and limonene) are 95% from oil.
In his paper, Bouwmeester et al. (1995) specify that the quality of cumin fruits depends on the content of carvene. In their paper, Rasooli and Allameh (2016) mention that carvone has antimicrobial and antioxidant potential.
In the extracts of cumin seeds and roots, a wide range of phenolic compounds has been highlighted (Ishikawa et al., 2002; Matsumara et al., 2002a; Najda et al., 2008).

3. ANTIMICROBIAL ACTIVITY

Clinical and food pathogens are increasingly resistant to conventional methods. Herbal oils are rich in antimicrobial compounds and can be a solution for chemotherapy and phytopharmaceutical formulas mixed with antibiotics. Research shows that this is possible. Cumin in the form of raw or extracts has a negative influence on the growth of pathogenic bacteria, phytopathogenic, Gram positive, Gram negative, but also fungi.
It was highly effective against the genera *Erwinia*, *Agrobacterium*, *Xanthomonas*, *Clavibacter*, *Curtobacterium*, *Rhodococcus*, *Ralstonia* and it has a lower effect on *Pseudomona*s (Iacobellis et al., 2005). In contrast, other studies state that cumin has a moderate inhibitory effect on many bacteria (*Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Mycobacterium tuberculosis*) and fungi (Toxopeus and Bouwmeester, 1992; Sadowska and Obidoska, 1998).
Of the 2 major components of cumin (carvone and limonene), a positive correlation was observed between antimicrobial activity and limonene, respectively a negative correlation between microorganisms and carvone (Seidler-Lozykowska et al., 2010)
Carvone is most often referred to as an effective antimicrobial (Gallucci et al., 2010; Morcia et al., 2016) because it is a monoterpen that interacts with the plasma membrane of microorganisms and affects its structure and functions (Sikkema et al., 1995).

4. CUMIN - AS A SPICE PLANT

Cumin belongs to the group of spicy plants, because it contains substances that give taste and aroma to food dishes and food in general. It has anti-degradation properties, can be used in raw form or as an extract for food preservation (Rasooli and Allameh, 2016).
Cumin is widely used in the food industry for flavoring food and beverages. It is used to season cheeses, meat, rye bread (Attokaran, 2017) in the preparation of vegetable soups and creams, especially in Central Europe and Scandinavia.
In ancient civilizations, all products of herbs were known as herbs. Today, there is a clear distinction between herbs and spices.
Spices and herbs have been used in magical rites, as incense, for fumigation, but also as food, preservatives, food additives, cosmetic ointments, perfumes and embalming.

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According to FAO data, including today, India and other Asian countries hold the leading positions in spice production.
In the Middle Ages, spices played an important economic role, especially in Europe. The spice trade was monopolized by Asian countries (especially Arab countries) (Narsimhan, 2009).
Like other spices, cumin has been used as a flavoring since ancient times in the Middle East. Some evidence is from 5,000 years ago. The commercial sources in Europe are the Netherlands and Germany. To the two cultivating countries are added the Netherlands, Poland, Russia, Denmark, Hungary, Norway, Morocco, Bulgaria, India, Turkey, Syria, Romania, etc. (Malhotra, 2006).

5. CUMIN - AS A MEDICINAL PLANT

Cumin is well known in traditional medicine. The use of cumin in medicine is related to its antioxidant properties (Lado et al., 2004), antimicrobial, carminative, and anti-inflammatory (Sivarajan et al., 1994), anti-flatulent, antispasmodic and galactogogue (Malhotra, 2006). It is used in lung diseases and gastrointestinal disorders (Johri et al., 2011), as evidenced by the presence of cumin on the EU list (Mahboubi, 2019).
It is a good digestive stimulant, expectorant, antispasmodic (Peter, 2006). In the Iranian tradition, cumin is believed to have an antiepileptic effect.
Research by Keshavarz and co-workers (2013) on mice shows that cumin is effective against colitis and lung disease (Joshi et al., 2000). Gastrointestinal protectors are considered carvone and limonene (Zheng et al., 1992).
Volatile cumin oil has been shown to have a hepatoprotective role and under certain conditions may also be a renal protector (Dadkhah et al., 2011). Cumin seeds are also used in veterinary medicine.
Cumin oil is used in various therapeutic formulations against scabies and fungal infections (Pruthi, 2001; Duke, 2002).
Rasooli and Allameh (2016) emphasize that the bioactivity of cumin is accentuated by the synergism of the compounds in the oils, which is why they recommend their use in the mixture.
Regarding toxicity, Tabarraei et al., (2019) demonstrated that black cumin essential oil does not affect body organs, enzymatic activity, immunity and circulation.

6. OTHER USES OF CUMIN

In the oils obtained by Trifan et al. (2016) from cumin fruits grown in northeastern Romania were dominated: carvone (48.53%) and limonene (44.42%).
The authors specify that this oil has a high antioxidant capacity, therefore it can be used in the food industry, as a preservative, in cosmetics and in the pharmaceutical industry.
Caraway essential oil is used as an ingredient in soaps, lotions and perfumes.
Fang et al., (2010) proved that *Carum carvi* L. oil is a good insecticide. The composition of the oil was dominated by carvone (37.98%) and limonene (26.55%), α-pinene (5.21), cis-carveol (5.01%), etc.

7. CONCLUSIONS

Seed and root can be used from cumin, both of which are rich in primary and secondary metabolites.
Cumin oils are rich in bioactive compounds, of which studies mention especially carvone and limonene.

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The effectiveness of oils against bacteria and fungi can be high or medium, depending on the genotype.
The biological activity against fungi, phytopathogenic and pathogenic bacteria in clinics (especially those resistant to methicillin) can be considered for obtaining bioproducts against plant diseases, functional foods, with an improved content, an efficient way of preservation and new phytopharmaceutical formulas that may contain compounds present in cumin (especially carvone, limonene).

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