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## SPICE OLEORESINS- A REVIEW

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### Abstract

Oleoresins are concentrated extracts from plants, spices, and herbs which have been studied as additives in foods. Extracted from natural sources by different techniques, they are potential substitutes for synthetic additives. They can promote antimicrobial, antioxidant, anti-cancer, and anti-inflammatory activity to products. The solvent extraction method is the most used, but new technologies considered green are being applied. Also, the microencapsulation of these extracts has been explored as a way to protect and facilitate the delivery of active compounds in food.

This review summarizes the most used oleoresin extraction methods, the main extracts used in the food industry, and describes the characteristics of the main compounds. Volatile and non-volatile compounds can be present and different methodologies for identification and quantification are used. This work also presents a brief description of the most used oleoresin encapsulation methods and lists recent studies providing an overview on the application of this promising ingredient.

### INTRODUCTION

The main oleoresins applied by the food industry are from black pepper, cinnamon, ginger, paprika and turmeric. In addition to color and flavor, different biological properties arouse the industry's interest in these extracts. The chemical diversity of the compounds present in oleoresins is what gives all these properties. Despite all this, oleoresins oxidize when exposed to factors such as oxygen, light, and temperature. Microencapsulation has been used to work around this problem and to facilitate the application of these viscous extracts in foods<sup>2</sup>

*“Globalization began with the spice trade. It was the world’s first long distance exchange, its most profitable and for two millennia its most mysterious.”* by John Keay.



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The Indian story of value added spice products began in the early 1970s. Over the years, with investments in quality and supply chain management, it has emerged to be the largest in the world. It is not only a local sourcing and processing point but also changed itself as a value addition hub for the spice crops from the Asia-Pacific region and elsewhere across the globe.

India is universally recognized as the "spice country" because of the occurrence of a wide variety of spices, condiments and herbs which are used in culinary preparations by population across the country. However the major focus for the spice extractive industry has been on Chilli, Black pepper, Ginger, Turmeric and Cardamom. While Cardamom oil is a much valued flavor material for hundreds of food preparations and beverages, whole spice extractives, more commonly referred to as oleoresins, have become important ingredients for the food industry for incorporation in many processed food products. Oleoresins with standard and reliable "active constituent" concentration have several advantages compared to use of whole spices, hence the preference by the industry.

Spice are essential ingredients of our food and eatables. But their use is not limited to food only. It serves many other functions in industry like preservative. Ingredients of spice are extracted and used in various application in food industry. Oleresins, oils and other ingredients are obtained from spice for various uses.

Spices are used for flavour, colour, aroma and preservation of food or beverages. Spices may be derived from many parts of the plant: bark, buds, flowers, fruits, leaves, rhizomes, roots, seeds, stigmas and styles or the entire plant tops. There is a continuing and expanding international demand for herbs, spices and essential oils. Social changes, including food diversification, the desire for new flavours, increasing importance of "ethnic" food and the increased importance of processed food, which requires condiments and aromatic herbs for its preparation, are driving an increase in this demand. Developing countries have a significant opportunity to benefit from this increasing demand. Many of the products can be sold in a dried form or as extracts (e.g. essential



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oils), which gives them a high value per unit weight. These products could be a profitable source of diversification for small farmers in developing countries.<sup>5</sup>

### **Methods of Extraction of spice oleoresins:**

Oleoresins are extracted by **solvent extraction or supercritical fluid extraction process**. The spice oleoresins are extracted by steam distillation. The essential oils are endowed with the major part of the flavor and fragrance properties of the spices. The spice oleoresins are obtained by extraction of dry ground spices with an organic solvent mixture such as ethylene chloride, acetone, hexane or alcohol. It contains all volatile and non-volatile constituents of spice, closely represents the total flavor of fresh spice in concentrated form. The residual solvent of the oleoresins should be below 30ppm.<sup>1</sup>

### **Overview of The Industry:**

In India the export of spice oils and oleoresins during 1967-97 reached a record high of 2358 MT (metric ton) valued to Rs.1.59crores. This export was against 1355MT valued to Rs. 7.16 crores in 1993-94, registered an increase of about 78% in quantity. The substantial increase in export during 1996-97 was due to increase in export of paprika. The spice oils and oleoresins account for more than 80% of export earnings from value added spices. Oils and oleoresins of pepper largely exported from India followed by oils and oleoresins of ginger, chilli, turmeric, and other seed spices.<sup>6</sup>

The export of spice oleoresins and essential oils from India amounts to 7,800 tonnes in volume and US\$ 255 million in value (2009-12). The industry has witnessed steady growth in volume and value since the beginning. The post liberalisation economic environment in India facilitated the import of raw materials from Asia-Pacific regions; and the industry leveraged on this to become a processing hub ensuring competitiveness and managing the supply chain effectively.



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## **Oleoresin Products from India**

Black pepper, Capsicum, Cardamom ,Cassia ,Celery, Cinnamon, Clove, Coffee, Coriander, Curry Leaf, Decalepis, Dill Seed, Fennel, Fenugreek, Garlic ,Ginger, Hing ,Jalapeno, Pepper, Mace ,Mustard, Nutmeg, Onion, Paprik,a Pimento, Rosemary, Tamarind, Turmeric ,White Pepper etc.<sup>3</sup>

**Important components of Oleoresins:** oleoresins are increasingly becoming important for pharmaceutical industry with many applications being considered effective in treating several human afflictions. Curcuminoids in Turmeric, Piperine in Black pepper and Capsaicin in Red Chilli, are the three major materials of commercial importance. These phytochemicals have been proved to be of excellent nutraceutical value capable of preempting or curing most of the disease conditions that human race faces today. Recent revelation that curcumin and piperine are effective in killing stem cells that differentiate into breast cancer cells, is of prime importance to the medical community. Similarly capsaicin has been proven to be effective in treating prostate cancer besides an excellent resource to treat inflammation, pain relief, fight sinus infection, irritable bowel syndrome, burning body fat, reducing cholesterol and triglycerides, dissolving clot inducing fibrin, preventing platelet aggregation and protecting the heart, relief from arthritis, psoriasis and diabetic neuropathy.

If these claims are true a time may come when oleoresins may not be available to the food industry with demand from the pharmaceutical industry outstripping that from the former. Probably cultivation of crops like Chilli, Black Pepper and Turmeric may expand several fold as commercial non-food crops! Such developments may also spur synthetic organic chemists to look for synthetic routes to make these much valued substances. Already synthetic capsaicin is available in the market and time may not be far off when synthetic versions of others start appearing. The present preference for natural sources for internal consumption is the only constraint that stands in the way of synthetic analogs dominating the market.<sup>1</sup>



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## Why Oleoresins?

Achieving efficient and consistent results using ground spices is a challenging task. Oleoresins can replace the original ground spice with a standardized taste and aroma that can be tailored as per the requirement of the product. They are economical, with easier quality control, and require lesser storage space. They have a longer shelf life, are cleaner (no bacterial contamination) and are a convenient substitute for ground spices.

## Advantages of oleoresins

- Easy to store and transport
- More stable when heated
- More economical to use
- Easier to control for quality and cleaner than the equivalent ground spices
- Free from contamination
- Concentrated form reduces storage space and bulk handling and transport requirements
- Concentrated and virtually moisture-free form of oleoresins ensures longer shelf life due to minimal oxidative degradation or loss of flavor
- Big potential for new product development.
- Consistency in flavour.
- Convenience of use - can be blended to achieve the desired characteristics.
- Convenient hygienic substitutes for spice powders in fortifying flavor profiles of food products.
- Full release of flavor during cooking.
- Much longer shelf life.
- Negligible moisture content.
- Zero bacterial contamination.



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### Applications:<sup>3</sup>

spice oleoresins can be used across industries like Food industries, pharmaceutical industries, cosmetic industries, confectionary, health & wellness, personal care , for agriculture and livestock, baby products, supplement products, As antioxidants, culinary,

- **Bakery** : Cereal, energy bars crackers and crispbreads
- **Beverages**: Carbonated beverages, meal replacements, tea & ready-to-drink beverages.
- **Dairy**: Dry milk, fermented milk beverages, flavored milk, milk drinks, milk based meal replacements & yogurt.
- **Processed food**: Energy, sport, and isotonic drinks & chewing gums.
- **Soup**: Canned soups
- **Flavouring Agent**: Due to its pungent effect it is used to provide flavour in food products.
- **Coloring Agent**: Coloring of food, eatables and medicines is common application where chilli oleoresin gives a range of red color.
- **Safety Gear**: It is used in making safety gear for girls and can make a person blind for few minutes.
- **Preservative**: Capsaicinoids help to preserve the meat and other food items against microbial activity.
- **Pharmacological**: Chilli oleoresin possesses anti-oxidant, analgesia, anticancer & anti-inflammation features. It radically reduce free radicals in our body.

### Main plant Oleoresins used in food industry

According to the data presented by the Grand View Research Database (Grand View Research, 2018) black pepper, cinnamon, ginger, capsicum and turmeric are considered the main raw material of oleoresins in the global market. The characteristics and main applications of these extracts are described in the following section.



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## **Chemical composition and characterization of spice oleoresins**

The chemical characterization of oleoresins is carried out with the use of different analytical techniques, including spectroscopy, spectrophotometry, and chromatographic methods or its combination (hyphenated techniques) Few studies are focused on the exclusive use of spectroscopic techniques such as infrared (IR) and nuclear magnetic resonance (NMR) to characterize oleoresins. Generally, they are complementary to chromatographic <sup>2</sup>

## **Oleoresin as a value-added ingredient using microencapsulation techniques**

The primary function of oleoresins in the food industry is to provide flavor, aroma and color to foodstuffs. Cinnamon oleoresin as a flavoring agent gives a sweet taste, while hot sensory characteristics are given by chili peppers extracts. Pungent effect can be obtained with ginger and black pepper oleoresins and coloring function are mainly for paprika and turmeric. They may also present, as a secondary effect, preservative action and health benefit properties <sup>3</sup>

Spices have exceptionally rich in vitamins, micro- and macro molecules, as well as a broad range of bioactive phytochemicals such as phenolics and saponins among others, which are known to possess antioxidant activity. Phytochemicals are highly variable due to their geographical origin, cultivar, processing factor, and analytical methodology. Therefore, this review intends to summarize the major compounds in spices that have shown biological activities.

## **Pepper Oleoresin**

Pepper oleoresin is used in a number of products such as medical supplements and culinary products. Pepper (*Piper nigrum* L) belongs to the Piperaceae family and is one of the well-known spices globally. It is commonly used as a household spice as a food additive and condiment. In addition, it is also used in traditional medicine for various medicinal purposes in many countries.<sup>8</sup> Piperine is a major alkaloid and a pungent nitrogenous substance present in the pepper fruit. Pharmacological studies on the activity of piperine have reported that it has anti-inflammatory and analgesic effect,<sup>9</sup> cognitive-enhancing effects,<sup>12</sup> cytoprotective





effects and antioxidant activity, antidepressant effects, antiulcer effects, etc. It is also reported that piperine has a protective effect on neurodegeneration and cognitive impairment.<sup>6</sup>

**Black pepper oleoresin** is extracted from dried berries of *piper nigrum*. It is widely cultivated in India. Stimulant to appetite as well as an aid in the relief of nausea, dysentery, dyspepsia.. Acts as a central nervous system depressant and suppresses fever and pain.Exhibits anti-inflammatory and insecticidal properties. Used in arthritis as a pain reliever.Piperine enhances the bioavailability of various nutrients through increased absorption.

Applications:

1. **Food:**Used as a flavor in food applications & as table condiment.
2. **Preservative:**In meat products it is used for curing and preserving.
3. **Pharmaceuticals:** Due to anti-oxidant and anti-inflammatory properties it has many applications in pharmaceutical

### **Turmeri Oleoresin**

Turmeric (*Curcuma longa*) is a rhizomatous perennial plant and belongs to the family Zingiberaceae. It is used as a spice and coloring agent and in traditional medicine, particularly in South Asia. Traditionally, it is used for wound healing, inflammation, asthma, high cholesterol, etc. The main active component of turmeric is turmerone oil and water-soluble curcuminoids, including curcumin. The medicinal properties of curcumin have been studied, particularly on anticancer activity.<sup>17,18</sup> It is also reported that curcumin exhibits antioxidant and anti-inflammatory activities and has potential in a transgenic mouse model in AD. Curcumin has shown the potential to inhibit the formation of A $\beta$  fibril, and destabilizing the preformed fibril can provide protection in AD and inhibit lipid peroxidation in the rat brain homogenate.<sup>23,24</sup> In addition to this, it also inhibits in vitro A $\beta$  fibril formation and





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protects the cells from A $\beta$  insults.<sup>25,26</sup> This supports that turmeric has potential in AD treatment.<sup>5</sup>

Applications:

- 1. Food:** Turmeric oil is used in food for coloring and spice effect.
2. Turmeric oil is used extensively for cosmetics as it makes our skin glow.
3. It can also be used as an ingredient in toothpastes.

of Ach and suggests that it can be used in the treatment of AD, Parkinson's disease, myasthenia gravis, ataxia, and senile dementia.<sup>30</sup>

Although many anti-AD drugs have been approved by the FDA, they have adverse effects such as dizziness, tiredness, nausea, vomiting, heart attack, and stroke. These drugs include AChE inhibitors, anti-inflammatory drugs, receptor antagonists, and monoamine oxidase inhibitors.<sup>31</sup> Thus, the prevention of AD with natural products has been gaining interest recently. Considering the above points, this study was aimed to evaluate the effect of spice oleoresins in Alzheimer's type of cognitive impairment using rat models.<sup>4</sup>

### **Few Examples Of Spice Oleoresins Available in Market :**

#### **CO<sub>2</sub>extractedoleoresins**

CO<sub>2</sub> extracted oleoresins unlike solvent extracted oleoresins, do not have any alcoholic residues in the final oleoresin. These oleoresins are much more expensive and can be used in products such as baby foods or foods in the health industry.

#### **WellbeingOleoresins**

This range of oleoresins cover highly concentrated products such as capsicum 95% capsaicin or turmeric 95% curcumin. These oleoresins are used in products such supplements for cancer and heat balms.



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### **Rosemary Oleoresin**

Rosemary oleoresin is popular alternative to dried oleoresin in culinary products. Rosemary Oleoresin is provided in oil and water soluble varieties and can be used in products such as canned fish, beef jerky. Rosemary oleoresin is also used as a anti-oxidant in oil products such as soaps and specialty oils. In some natural organic liquid fertilisers, water soluble rosemary oleoresin is also used as a effective anti-oxidant. Turmeric oleoresin is used in a number of products such as medical supplements and culinary products. Turmeric has natural properties that may aid in the treatment of various forms of cancer. Turmeric oil finds applications in the pharmaceutical industry because of its role in relieving pain, anxiety and stress; fighting physical and mental depression, etc. It also is a popular insect repellent. The benefits of turmeric on the skin have been well proved.

### **Capsicum Oleoresin**

Capsicum oleoresin is used in a number of products such as pepper spray, heat balms and culinary products

**Red Chilli:** Chilli oleoresin compounds are used extensively in pharmaceuticals industry. Capsaicinoids are quite effective as analgesia, anticancer, anti-inflammation, antioxidant and anti-obesity. Capsaicinoids may have potential application in pain relief, cancer prevention and weight loss. In addition, capsaicinoids also display the benefits on cardiovascular and gastrointestinal system. Chili (*Capsicum annum*L) belongs to the family Solanaceae. It is one of the major spices cultivated worldwide. It has bioactive components with antioxidant activities such as vitamin C, vitamin E, carotenoids, polyphenols, and alkaloids and provides health benefits.<sup>7</sup>Capsaicin is a major active component of chili, which has the potential for promoting vascular and metabolic health. It was reported that capsaicin has properties like analgesic, antiarthritic, anticancer, and antioxidant properties. The study has shown that capsicum oleoresin increases the availability



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## Conclusion

Oleoresins are natural extracts rich in bioactive compounds. The use of green extraction technologies can increase yield and improve their quality. Pigments and phenolic compounds are the main non-volatile compounds present in oleoresins, and HPLC is the most used analytical separation technique to characterize the extracts. Among the volatile compounds, esters, aldehydes, alcohols, and some terpenes stand out.

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