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EXTRACTION OF ESSENTIAL OIL FROM CORIANDER SEED

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ABSTRACT

Coriander (*Coriandrium sativum*) is an annual herb having family Apiaceae. It is main source of essential oil particularly petroselinic acid (68.8%) and linoleic acid (16.6 %). An essential oil from the seed is used as food flavouring, in perfumery and soap making, etc. Semi-continuous supercritical carbon dioxide extraction unit was used to extract the essential oil from the coriander seeds. Dried seeds were subjected to extraction after grinding to particle size of 300μm. The extraction was carried out at three different pressure levels (30, 35 and 40 MPa), three temperature levels (308, 313, 318 K) and three levels of supercritical CO_2 flow rates (10, 15, 20 g/min). The highest essential oil was obtained at 40MPa, 313 K and 15 g/min combination of parameters and the highest yield was equal to 3.20g/100g. The study showed that the temperature has more significant effect than the pressure while the flow rate was having no significant effect on the yield of coriander seed oil. The study provides an opportunity to pharmaceutical/cosmetic industries to obtain the highly pure oil using the optimized conditions.

Key words: Coriander seed, Supercritical carbon dioxide, Temperature, Essential oil.

INTRODUCTION

A growing demand for natural products like bioactive compounds, flavours, fragrances and cosmetics has been observed in the past few years. Advancement in basic science provides wide range of technologies to extract the natural compound of high value such as medicinally active compound and essential oils. The choice of appropriate technology is depend on economic feasibility and suitability of the process to the particular situation. Several studies have investigated essential oil, bioactive compound and other substances extracted from medicinal plants and herbs. Considering their bioactivity and their presence in a wide range of vegetables, these compounds are considered natural antioxidants and the vegetable which are source that antioxidant functional food (McDonald *et.al.,* 2001)

Coriander (*Coriandrium sativum*) which is commonly known as an annual herb belongs to family *Apiaceae*. Coriander fruits are a common spice in many countries of Europe, Northern Africa, West, Central and South Asia due to its distinct aromatic properties. Coriander seeds are also used in perfumery and pharmacologically to disguise the taste of medicines, and to flavour gin and liqueurs. Leaves and seeds are used as flavouring in salads, soups, curries and many dishes. Traditionally, coriander seeds are used as a diuretic, dyspepsia and indigestion, seeds lotion for rheumatic pain. The flavour of coriander seed is mainly due to its essential oil content which having petroselinic acid (68.8%) and linoleic acid (16.6 %) as major constituents. An essential oil from the seed is used as food flavouring, in perfumery and soap making, etc.

Steam distillation is a traditional method of extraction of an essential oil from coriander seeds. The alteration of chemical constituents of essential oils is a major problem associated with hydro-distillation methods this leads to destruction of the heat-sensitive compounds. Therefore, the quality of the essential oil extracts is extremely impaired. Solvent extraction is an alternative to steam distillation method but the method also has problem of destruction of thermally liable constituents due to application of high temperatures (Romvari 1976; Stahl *et.al.,* 1987).

The problems can be addressed by the use of green processing technology i.e. supercritical carbon dioxide extraction method (Said et al. 2014). Since last two decades, efforts have been made in the direction of extraction of some high value materials of importance in the food, cosmetic and pharmaceutical industries (El Dengawy *et.al,.* 2001; Sanderson 2011). Near, sub and supercritical extraction of essential oil from coriander seeds has been reported by some investigators (Stahl and Gerard 1985). They have extracted oil at different pressures and temperature levels but the effect of process parameters were not studied. The present investigation was aimed to optimize process to extract essential oil from coriander seeds after detailed study on effect of processes parameter on its yield.

MATERIALS AND METHODS

The sample of coriander seeds was collected from local market of Varanasi, Uttar Pradesh. A cylinder of carbon dioxide (99% purity) was supplied by Luthra Gas

Supplier, Varanasi. Analytical grade n-hexane (Boiling point: 65.5°C), CDH laboratory reagent was purchased from Central Drug House (P) LTD, New Delhi. The moisture content and oil content of coriander seeds were determines as per procedure given in the AOAC method (1980).

A batch type SFE 500 model of Thar technologies was used to optimize the process parameters. Prior to experimentation, seeds were finely powdered to size of about 250 µm. The grinding is done to enhance extraction process through enlargement of surface area. During experimentation, sample was mixed with glass beads to achieve ration of 2:1 v/v. The process parameters were controlled using "*Process Suite software*". In each experiment, 100 g sample was charged into the extraction vessel along with glass beads and run for about 4 hours or up to completion of extraction. The extract was collected at every 30 minutes interval to insure completion of extraction process, and obtained oil was weighed immediately after collection.

An orthogonal array design (L9 (3^3) was used to organize the combination of the process parameters. All statistical analysis was carried out using Minitab 16.1 (Minitab Inc. State college, PA, USA).

RESULTS AND DISCUSSION

The coriander seeds were found to have moisture content of about 11.37 %. The soxhlet analysis showed that the seeds have 3.0 % oil content. This value may be affected by high temperatures due to volatility of some compounds present in essential oils. The results obtained using supercritical carbon dioxide extraction method to extract coriander seed essential oil are as shown in Table 1.

Table 1 Yield of essential oil (g/100g) using supercritical carbon dioxide

Pressure (MPa)	Temperature (K)	CO_2 Flow rate (g/min)	Extraction yield g/100g
30	303	10	2.16
30	313	15	2.28
30	318	20	2.3
35	303	15	2.41
35	313	20	2.46
35	318	10	2.55
40	303	20	2.86
40	313	15	3.2
40	318	10	2.98

The analysis of results showed that at higher pressure of 40 MPa, and temperature of 313 K was significantly higher for flow rate of 15 g/min and the maximum yield was 3.2 g/100g. The detailed study of each parameter effect is explained in subsequent paragraphs.

EFFECT OF EXTRACTION PRESSURE

The extraction pressure is a crucial parameter in pressurized extraction i.e. supercritical carbon dioxide extraction. The results showed the similar behavior which was observed by number of researchers i.e. increase in the pressure increases the oil yield (Figure 1). In orthogonal array design, three levels of pressure were selected (30, 35 and 40 MPa).

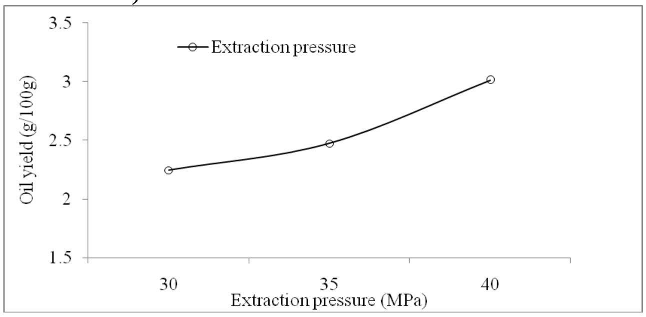

Figure 1- Effect of extraction pressure on extraction yield

The relationship between pressure and yield was mainly due to variation in the solvent density and the solvent power of supercritical CO_2. At constant temperature, density of the solvent increases but the vapor pressure of the solute decreases with increase in pressure. However, elevation of pressure showed a positive effect on the extraction as increase in solvent density with pressure dominates over vapor pressure of solute. This dominancy caused the release of maximum oil from cell walls and results in increased oil yield.

EFFECT OF EXTRACTION TEMPERATURE

Three levels of orthogonal arrays were 303, 313 and 318K. The temperature increment resulted in little increase in yield up to 313K but further increase in temperature showed decreasing of oil yield (Figure 2).

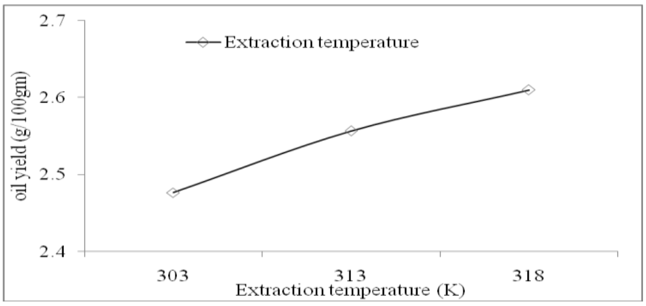

Figure 2 - Effect of extraction temperature on extraction yield

The result showed that at higher pressure, solute vapor pressure increased with temperature compared to solvent vapor pressure. But after 313 the extraction yield was started to decrease due to start of crossover effect which is explained by Said *et.al*,. (2014) in their literature and thermal degradation of volatile compounds as well.

EFFECT OF VOLUMETRIC CO_2 FLOW RATE

Though different literature showed non-significant effect carbon dioxide flow rate on the yield of extracting compound, an optimum flow rate must be required to obtain sufficient yield and to shorten the extraction time. Hence study was conducted at three different flow rates i.e. 10, 15 and 20 g/min. the result showed that increase in flow rate caused increase of essential oil yield (Figure 3). But more the flow rate more will be the loss of CO_2 which increases the cost of product. Since the flow rate of 15 g/min was recommended as the combination of 40MPa, 313 K and 15 g/min have highest oil yield.

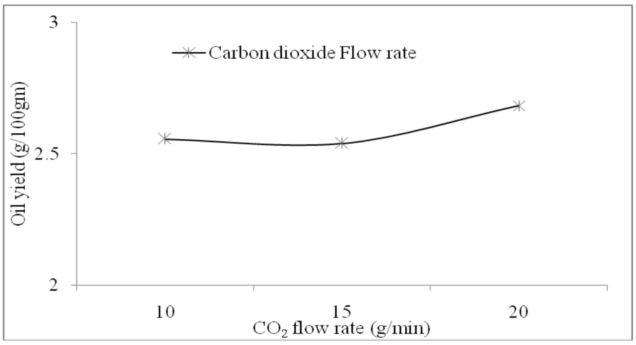

Figure 3Effect of volumetric CO_2 flow rate on extraction yield

CONCLUSION

Coriander (Coriandrium sativum) is an annual herb having family Apiaceae. It is main source of essential oil particularly petroselinic acid (68.8%) and linoleic acid (16.6 %). An essential oil from the seed is used as food flavouring. The study showed that the temperature has more significant effect than the pressure while the flow rate was having no significant effect on the yield of coriander seed oil. The study provides an opportunity to pharmaceutical/cosmetic industries to obtain the highly pure oil using the optimized conditions. Supercritical fluids can be considered in a prominent way in the development processes of drug products for the 21st century.

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