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Effect of supercritical extraction parameters on bioactive compounds.

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Introduction

An increasing interest is currently shown by researchers to natural bioactive substances, exploring any possible use as alternatives to synthetic compounds usually involved in food, pharmaceutical and cosmetic fields.
The clear evidence relating dietary modes and chronic illnesses, the limitations imposed on the use of food additives produced from synthetic chemicals as well as their banishment in some food products, made the incorporation of natural food additives as one of the most important trends in the food industry, nowadays.
An ideal extraction method should be fast and easy to operate in order to lead to a quantitative and qualitative recovery without any compound degradation along with an easy separation of the extracts from the solvent. The development and application of alternative green technology to replace conventional extraction methods with improved extraction efficiency and low environmental impact for the extraction of substances from natural bioactive compounds is therefore very important. Supercritical fluid technology may offer features that overcome many limitations of conventional extraction methods [1].

Objective

Supercritical CO2 extraction was carried out , investigating the effect of operating parameters like pressure (100-300 bar), temperature (35-55 °C), particle size (0.5-0.9 mm) at a fixed supercritical CO2 flow rate, on various performance criteria like the extraction yield from the bioactive compounds.

Materials and Methods

Fig.1 The Supercritical CO2 extraction pilot

The supercritical fluid extraction (Separex-4219) machine shown in Fig.1 was used. For each experimental run a mass of 50 g of crushed seeds were introduced into a 50 mL stainless steel cylindrical vessel the ends of which are protected by filter mesh screens to prevent any particles entrainment by supercritical phase. The duration of each run was around 3 hours, using supercritical CO2 at different conditions of temperature and pressure, and their bioactive compounds were identified using GC-MS method.

Resuts

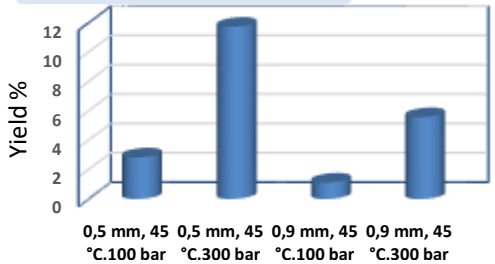

Fig 2, Experimental results extraction yields

Table 1: Oil extracts composition by Gc-Ms analyses (GC-MS),

	0.5 mm, 45°c, 300 bar	0.5 mm, 45°c, 100 bar	0.9 mm, 45°c, 100 bar	0.9 mm, 45°c, 300 bar
	%	%	%	%
C16H32O2	0.18	0.22	0.15	0.11
C20H42O	-	-	0.46	-
C16H34O	0.17	0.23	-	-
C19H36O2	0.21	-	-	0.15
C17H32O2	0.35	0.32	0.20	0.24
C17H34O2	15.29	14.48	10.49	13.15
C19H36O	-	-	-	0.24
C16H32O2	0.13	-	0.27	0.23
C15H26O2	-	0.19	-	-
C21H40O2	0.23	-		0.20
C18H36O2	0.25	0.21	-	-
C21H40O2	-	-	1.09	-
C19H34O2	45.18	47.69	53.21	48.50
C19H36O2 (E)	38.03	33.48	30.60	33.90
C19H36O2	-	2.97	-	3.30

- **Effect of operating parameters**

Different oil extracts obtained by means of the supercritical carbon dioxide extraction are shown in Fig.2.
Generally, a pressure increase induces a significant increase in the oil extraction yield. This is explained by the fact that a pressure increase of the supercritical solvent leads to an increase of the solvent power and a better oil solubility in solvent, resulting in an enhanced oil extraction yield [2]. In addition, It is clear that a small particle size provides more mass transfer area than a larger one. This is well followed by the results of Fig. 2 where for a given temperature and pressure, the highest yield corresponded to the smallest particle size. For instance for a particle size of 0.9 mm, a temperature of 45°C and a pressure of 300 bar, the yield was 5,58 %, and at the same conditions but for particle sizes of 0.5 mm, the corresponding yield values was 11,74%.
The chemical composition of the supercritical extracts of Peganum harmala was determined by gas chromatography coupled to mass spectrometry. Base compounds were identified in the extracts, with only three major compounds. Table 1 shows the composition of the oil changes according to the operating conditions used,

Conclusion

The present study has shown that carbon dioxide supercritical extraction can be used to valorize natural plants like Peganum harmala, present in abundance in nature, with no cost, no environmental impact, etc. It may also be an important source of oil characterized by an important biological activities that can be exploited in many applications in the agro-food, pharmaceutical industrial and cosmetic fields.

References

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