SUPERCRITICAL CO_2 EXTRACTION OF COSMETIC AND EDIBLE OIL FROM MOROCCAN ARGAN KERNELS: A NEW PERSPECTIVE FOR INDUTRIAL APPLICATION

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Argan tree (Argania spinosa L.) is an endemic tree from southern Morocco and Algeria. The oil extracted from argan seeds is mainly composed of monounsaturated and polyunsaturated fatty acids, carotenoids, sterols, tocopherols, and squalene. Argan oil is very well known for its antioxidant properties; it is a product of high added value mainly used in food, cosmetic and pharmaceutical industries in Maghreb and Europe. The production of edible oil is performed by mechanical cold-pressing or by traditional hand pressing from roasted argan kernels by using water. Non-roasted argan kernels are used to produce cosmetic oil after grinding and solvent extraction process. For industrial cosmetic applications argan oil is extracted from ground kernels using a lipophilic or halogenated solvent such as cyclohexane, petroleum ether, chloroform or dichloromethane. After solvent extraction process, the extraction yield is about 45-50 %. It is well-known that extraction processes using organic solvents like cyclohexane or dichloromethane which are toxic and non-selective lead inevitably to a separation steps which is time consuming and increase the production costs. A well-known alternative to organic solvent extraction is the supercritical CO_2 (SC-CO_2) extraction. SC-CO_2 is a GRAS (Generally Recognized As Safe) solvent, and thanks to its low critical temperature (304.21 K) it can be used to extract heat-sensitive components. No separation step is needed since CO_2 is gaseous at ambient conditions of pressure and temperature and it is recycled at industrial scale enabling a clean and compact process. Experimental and modelling investigations of SC-CO_2 extraction of oil from Argania spinosa L. unroasted and roasted kernels were conducted. Extraction kinetics and solubility determination were performed at pressure range from 200 to 400 bar, temperature range from 313 to 333 K at a CO_2 flow rate of 0.14 kg/h. Whatever the pressure and the temperature, the highest achievable yield was estimated at 0.63 kg_{oil} / $kg_{biomass}$, which is the highest reachable extraction yield (compared to 8 h n-hexane Soxhlet extraction). The extraction kinetics were modeled with Sovová's broken and intact cells model. The extraction of type B was found to be the most suited extraction type. Argan oil solubility in SC-CO_2 was modelled with the Chrastil equation and compared to empirical correlations. A retrograde solubility behaviour was observed at 200 bar and the most rapid extraction kinetics were found at 400 bar and 333 K leading to an extraction duration of 4 h. The total tocopherols concentration was found between 389.7 and 1688.6 mg/$kg_{extract}$. SC-CO_2 extraction kinetic on roasted kernels was slower than the one observed on unroasted kernels, the optimal particle size diameter for extraction kinetics was 750 µm.