ABSTRACT

Supercritical Fluid Extraction of Ylang Ylang

by

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Ylang ylang oil is traditionally extracted by hydro distillation and is commonly available in four grades, namely Extra, First, Second and Third. An unfractionated version is also commercially available as an ylang ylang complete.

In this dissertation, supercritical fluid extraction (SFE), as an alternate extraction technique for the production of ylang ylang oil, is investigated. Preliminary investigations include identifying the optimal time to harvest ylang ylang flowers with respect to season, flower maturity and time of day. Additionally, the order in which the quality defining components are extracted during SFE was examined, followed by a comparison of the supercritical fluid extract and the conventionally distilled ylang ylang extract.

Results show that large, yellow-green ylang ylang flowers displaying red spots at the base of each petal, harvested in the morning during the rainy season, yield the largest quantity of high quality ylang ylang oil. As with conventional hydro distillation, the concentration of the lighter, more delicate floral notes that constitute the ylang ylang First fraction is highest at the start of SFE with the

concentration of the heavier base notes increasing to a peak toward the end. Comparison with traditional hydro distillation revealed comparable oil yields, although the supercritical fluid extract contained many more compounds that effectively reduced the concentration of the quality defining components.

The second aspect of the research performed in this thesis comprised a two-part investigation into the effects of pressure, temperature and CO_2 flow rate on the extraction process as well as the resultant ylang ylang oil yield and quality. The rate of oil extraction was found to increase with all three of the variables investigated. Although both oil yield and quality increased with pressure and temperature, the oil quality was observed to decrease with increasing CO_2 flow rate. Taking into account both yield and quality, the optimal conditions for extraction were found to be 35^oC, 300bar and 3.0L/min expanded CO_2 gas.

The third aspect of this dissertation was to develop a mass transfer model that would predict the extraction of essential oils from floral matrices. A microscopic investigation of the ylang ylang petal structure and oil location was undertaken after realising that changes to the structure of the petal and its oil would invariably occur as a result of the extreme pressures inherent in supercritical fluid extraction process.

The findings of this study were then used as a basis to develop an accurate mass transfer model. The proposed extraction sequence included the diffusion of oil within the petal to the petal surface followed by the transfer of oil from the solid petal phase to the supercritical fluid phase and then finally the movement of

oil from the thin, stationary supercritical film surrounding the petal to the bulk of the supercritical fluid.

The proposed mass transfer model was then solved on an element-by-element basis yielding values of both the convective mass transfer coefficient and the solid phase diffusion coefficient.

Application of the proposed mass transfer model to the extraction conditions investigated allowed for the development of dimensionless correlations that define the mass transfer characteristics of this CO_2-ylang ylang oil extraction system. The accuracy of these correlations was evaluated and found to be satisfactory.

The versatility of the model was then explored using air-dried ginger rhizome extraction data. The predicted values of both mass transfer coefficients for the air-dried ginger were found to conform with published data confirming the versatility of the model and the validity of the findings on which it was based.

KEYWORDS: Marian Watson, mass transfer, supercritical fluid, carbon dioxide, ylang ylang