Extraction of musk fragrance oil from Ambrette seeds (Abelmoschus moschatus)

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Abstract: With the world focusing on finding natural alternatives for all possible products as a measure to protect the degrading environment, ambrette seed oil can be a novel replacement for synthetic musk used in the ever-growing perfume industry. Musk fragrance is one of the most popular base notes used in perfumes. Possible experimental methods for extraction of essential oil with the desired quality are reviewed and selection of solvent is discussed. The selection of the process is done based on the yield, quality of oil in terms of odour and shelf life.

***Index Terms* – Solvent extraction, steam distillation, polarity, ambrettolide.**

1. Introduction

The use of perfume can be traced back to the beginning of human civilisations. The earliest known perfumes were made with basic flowers, herbs and spices (crushed and preserved in oils). With the advancement in extraction techniques, perfumes were made by mixing different essential oils to get the desired fragrance. Natural essential oils were eventually replaced by synthetic fragrances to meet the ever-growing demand. Musk is used as a base note in perfumes to provide depth and solidity. It is naturally obtained by killing the musk deer which has now become an endangered species as a result of poaching. This led to the production of synthetic musk which has low biodegradability and tends to accumulate in the environment. It is known to cause an allergic reaction and hormone disruption.

A natural alternative to musk fragrance is Ambrette (*Abelmoschus moschatus).* It is a weedy shrub found in tropical regions like India and it is known for valuable scented seeds. A sweet, flowery, heavy fragrance similar to that of musk is found in the ambrette seed oil. The extract is widely used as a fixative in fragrance formulations [1]. It possesses a much smoother odour than synthetic musk compounds [2]. The components of the ambrette seed oil are (2E, 6E)-farnesyl acetate, (2Z, 6E)-farnesyl acetate, (Z)-7-hexadecen-16-olide, (Z)-9-octadecen18-olide, decyl acetate, β-farnesene, nerolidol, dodecyl acetate, (Z)-5-tetradecen-14-olide, (Z)-5-tetradecenyl acetate [4]. The characteristic musk fragrance is given by the component ambrettolide (Z)-7-hexadecen-16-olide [3].

2. Methods of extraction

2.1 Hypothesis

The presence of Ambretteloid in the outer seed coat has been widely reported. In a work by Nee, Cartt, and Pollard [4], the ambrette seeds were carefully analysed for the fragrance components, by dissecting them into outer and inner seed coats. The outer layer of seed coat was found to be exclusive location for the essential oil.

The boiling point of Ambretteloid is in the range of 398.00 to 399.00 °C at 760.00 mm Hg. It is insoluble in water.

Steam distillation can be considered as one of the extraction methods of ambrette seed oil. According to the principle, heating of a mixture of two or more immiscible liquids results in a combined vapour pressure exerted by the system. The contribution of vapour pressure by the steam allows for the vaporisation of elements with high boiling point at much lower temperatures merely by allowing them to form a mixture with water. Ambretteloid which has higher boiling point than water at atmospheric pressure and insoluble in it forms a separate layer, floating above the water layer thus enabling its separation using steam distillation.

Soxhlet extraction using solvents explores the possibility of extracting the ambrette seed oil from crushed seeds. A portion of non-volatile compound present in the ambrette seeds gets dissolved in the solvent during each cycle. After many cycles the desired compound is concentrated in the distillation flask. The main advantage of this extraction technique is that, one batch of solvent is recycled through the sample instead of many portions of it. The solvent selection is done on the basis of polarity. Ambretteloid being non-polar is extracted preferably using non-polar solvents.

3. Possible experimental methods

3.1 Steam distillation of whole seeds

P. K. Rout et al. [3] used the steam distillation of whole ambrette seeds placed in a round flask filled with water on a heating mantle. A Clevenger apparatus with a connection to the chiller was fitted to the flask. Insulation around the apparatus was done to prevent heat loss. Yield mentioned was 0.15-0.2 %. It was reported that the essential oil had a fatty odour and needed to be aged before use; low shelf life.

3.2 Solvent extraction using Soxhlet apparatus

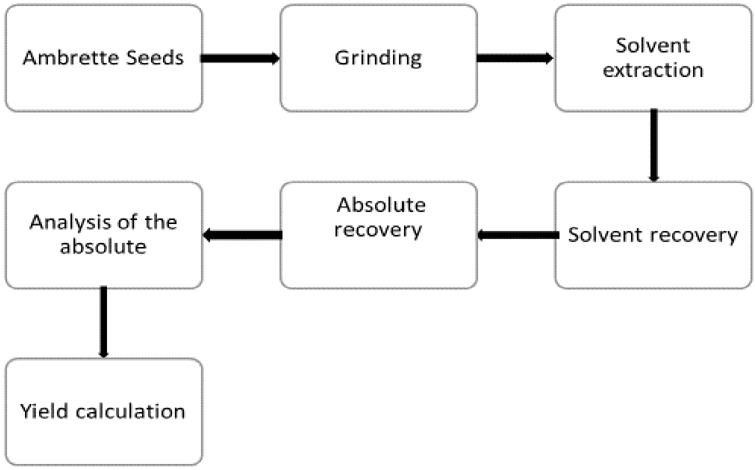

Figure 1: Flowsheet of solvent extraction

O.H Nautiyal et al. [5] reported the method of solvent extraction of crushed ambrette seeds with a yield of 0.6%. It involved placing powdered ambrette seeds in a thimble-holder. Condensed fresh solvent from a distillation flask gradually filled the thimble-holder. A siphon aspirated the whole contents of the thimble-holder when the liquid reached an overflow level, and unloaded it back into the distillation flask, carrying the extracted analytes in the bulk liquid. This operation was repeated until complete extraction was achieved. Solvent recovery was done using a rotary evaporator.

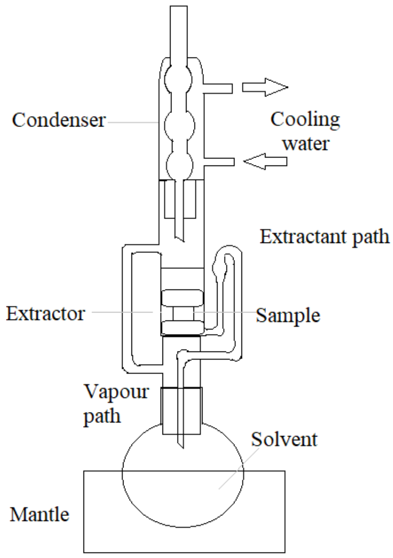

Figure 2: Soxhlet apparatus

3.2.1 Solvents used in extraction

Solvent	Solvent formula	Polar/Non-polar	Relative polarity	Boiling point (°C)
Pentane	C_5H_{12}	Non-polar	0.009	36.1
Hexane	C_6H_{14}	Non-polar	0.009	69
Pet ether	Mixture of pentane and hexane	Non-polar	0.009	42-62
Ethyl acetate	$C_4H_8O_2$	Polar aprotic	0.228	77
Chloroform	$CHCl_3$	Slightly polar	0.259	61.2
Acetone	$(CH_3)_2CO$	Polar aprotic	0.355	56.2
Ethanol	C_2H_5OH	Polar protic	0.654	78.5
Methanol	CH_3OH	Polar protic	0.762	64.6

Table 1: Solvent properties

Table 1 shows the polarity of solvents [6] used for extraction. Ambretteloid, the main component of ambrette seed oil is non-polar. Non-polar solvents extract non-polar components. It can be inferred that pet-ether and hexane are more suitable for the extraction of essential oil.

4. Discussion

Different extraction methods have been reported in several published literature. Work done by P. K. Rout et al. [3] suggests extraction of essential oil using steam distillation at some stage of processing, which gave a result of deterioration of the quality of the oil. They also reported that the extraction of oil from crushed seeds with alcohol and rectification by crystallization and fractionation gave a higher yield than steam distillation.

O.H. Nautiyal et al. [5] worked on solvent extraction of crushed ambrette seeds using soxhlet apparatus. They suggested using benzene, petroleum ether as the solvent. Their absolute yield was high against values reported earlier.

In terms of process selection for extraction of ambrette seed oil, solvent extraction seems to give a higher yield than steam distillation. The selection of solvent for solvent extraction based on its polarity, suggests using Pet-ether and hexane over others. For the quality of the oil, while steam distillation produced an oil with a fatty odour and low shelf life [3], Solvent extraction using the Soxhlet apparatus gave a highly fragrant oil with a musky odour [5].

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