A review on *Aquilaria malaccensis* propagation and production of secondary metabolite from callus

Presented by,

Suklang Kharnaior

Ph.D Scholar

Department of Biosciences Assam Don Bosco University
Tapesia Gardens, Kamarkuchi, Sonapur, India

Contents

Introduction

Aquilaria malaccenis is one of the precarious non-timber wood of the fifteen species, of genera *Gyrinorops* and *Aquilaria*, and belongs to the family *Thymelecea*

Commonly known as agarwood

Chiefly distributed over several countries such as India, Bangladesh, Malaysia, Myanmar, China, Singapore, Bhutan, Vietnam, Indonesia, and Thailand (Oldfield & Mackinven, 1998)

The species is listed in the appendix I and II of CITES in 2004

In India, there are three endemic species viz. *A. khasiana* Hallier, *A. macrophylla* Miq. and *A. malaccensis*

The objective of this paper is to compile the major research works on the conservation and production of secondary metabolite

Figure 1: *Aquilaria malaccenis* (A) Tree (B) Flower (C) Fruits (D) Immature and matured seeds

Economical value

There are three: perfume, incense stick and pharmaceutical use

Perfume - Traditionally in the Middle East, agarwood smoke and oil are used as a scent (Chakrabarty et al, 1994), and Minyak attar (water-based) is a distilled agarwood oil use by the Muslims to prayer clothes (Yacoob, 1999.

Agarwood fragrance is also being employed as an aromatic gradient in detergent, viz soap, and shampoo (Kadir et al, 1997).

Several researchers were synthesizing agarwood aromatic compounds to match with the chemical structure of the ordinary oil but in low quality (Beek and Philips, 1999).

Incense stick (Charkraborty et al, 1994)

It has a magnificent account in prayers and religious ritual purposes, insect repellent and to bring safety and luck

In Taiwan, In Taiwan, the agarwood stick is used in traditional festivals or ceremonies to bring safety and good luck to the believer

The quality of Indian and Chinese agarwood incense stick has drop down, as reported the agarwood oil concentration is less or they might have replaced with synthetic oil

Pharmaceuticals use – Traditionally agarwood is prescribed to treat pleurisy by the Sahih Muslim, relieve pain, arrest vomiting, and asthma (Anon, 1995).

Uninfected wood - use for the treatment of jaundice and body pain (Chakrabarty, 1994)

Infected wood - high-grade quality for the treatment of various diseases and production of pharmaceutical tinctures (Yacoob 1999, Beek and Philip, 1999)

Ayurveda – treating various diseases such as as appetizer, analgesic, antipyretic, antihistaminic, styptic, carminative, cytotoxic, insecticidal, general tonic, etc. (Sarma et al, 2015)

Propagation of *A. malaccensis*

Traditional method

Mass production – produce by grafting, stem cutting, and seedling

A prediction test on seed weight was observed the heavier seeds have higher supremacy for a great germination and seedling growth in contrast to the lighter seeds (Shankar, 2012)

The seed is recalcitrant and its shelf life ranging from 15 to 40 days at room temperature (Shankar 2012, Tabin and Srivastava, 2014)

To enhance the traditional method stem cutting was developed by treating the injured stems with various concentrations of Indole Butyric Acid (IBA) for rooting development (Borpuzari & Kachari, 2018)

Biotechnological technique to improve traditional method

Callus induction - an efficient callus from the leaf tissues of *A. malaccensis* in murashige and Skoog (MS) medium supplemented with BAP (0.5mg/l) + NAA (3mg/l) and 4% of sucrose (Saikia et al, 2012)

MS medium more appropriate than Woody Plant Medium (WPM) with the supplementation of 2,4-dichlorophenoxyacetic acid + kinetin (Saikia et al, 2013)

The auxin hormones (NAA at 1.1 µM) produce compact callus whereas combination with cytokinin (BAP 2.2 µM) and 15 g/l produces friable callus (Jayaraman et al, 2014)

Embryogenic callus was observed in MS medium with 2.0 mg/l BAP and 0.5 mg/l 2, 4-D (Salam and Abdullah, 2019)

Hamdan et al. (2020) reported an innovative method to study the embryogenic formation of callus by using SEM (Scan Electron Microscope), and the genes (SERK, BBM, LEC1, and WOX) associated with somatic embryogenesis

Shoot induction – optimal shoot was obtained from the shoot tip and lateral bud in modified MS medium containing 0.5 mg/l BAP and 0.25 mg/l TDZ and roots was developed in a ½ strength MS mdium containing 1 mg/l IBA (sabdin et al, 2011)

Direct organogenesis – was determined in a medium with high concentration of BAP 2mg/l and low concentration of NAA 0.1 mg/l where roots was developed in ½ MS medium with 1 mg/l NAA (Saikia & Shrivastava, 2015)

Synthetic seed – an artificial seed was developed by encapsulated the nodal bud with 2.5 % sodium alginate and 100 mM calcium chloride (Devi et al, 2018)

Secondary metabolite production

Okudera et al. (2009) studied the production of two major compound from the callus i.e. sesquiterpenoids from the living cells and chromones might generate from the dead cells.

Siah et al. (2016) reveal that the genes obtain from senescence callus actuate the identical response as infected agarwood in aromatic compound synthesis and defense response pathways

Sen et al. (2017) conducted a study to enhance the mechanism of plant and microbes interaction on three categories, viz. callus, juvenile plants, and resinous wood chips infected with *Fusarium*

Future prospects

The in-vitro techniques determine an alternative source for agarwood production from mass cell/callus of *Aquilaria* species

Although the callus induction using leaf, nodal, and shoot explants are reported by various researchers, other parts from the vegetative and reproductive phase are also might be the best explants

No work has been reported so far for the production of plantlets from the callus

Further research is highly recommended to improve the *in vitro*, *in vivo* method for the mass production of *aquilaria* tree

As reported by various researchers callus impersonates a significant character in the production of unique secondary metabolites

For further studies, a comparative study could be done for the isolation, identification, and classification of microorganisms and compounds

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Thank you