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UNIVERSITI TEKNOLOGI MARA

**FRUIT RIPENESS IN RELATION TO
STORABILITY FOR MEDICINAL PRODUCT
DEVELOPMENT AND SEED VIABILITY OF
*Phaleria macrocarpa***

SUAAD MOHAMED AHMED ASRITY

Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

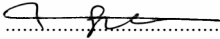
Faculty of Plantation and Agrotechnology

June 2016

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Postgraduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Suaad Mohamed Ahmed Asrity
Student I.D. No.	:	2009593759
Programme	:	Doctor of Philosophy - AT990
Faculty	:	Faculty of Plantation and Agrotechnology
Thesis Title	:	Fruit Ripeness in relation to Storability for Medicinal Product Development and Seed Viability of <i>Phaleria macrocarpa</i>
Signature of Student	:	
Date	:	June 2016

ABSTRACT

Phaleria macrocarpa, or also known as Mahkota Dewa, is popular medicinal plant in Indonesia and has recently been introduced in Malaysia in view of its commercial potential as health supplements. Many studies have focused on the active compounds in fruit, which is primarily used in medicinal products, but postharvest handling of the fruits has not been well documented. Studies were, hence, carried out to determine the relationship between fruit ripeness, morphological and chemical properties, and changes during fruit storage prior to product development for safety and optimum health benefits. Besides, the seeds within them are also primary means of propagation as vegetative multiplication of this plant species is of low success. Results showed that fruit of drupe of this medicinal plant had respiration rate, size and weight increased while become more juicy as ripening progressed from full size unripe to fully ripe stage. It is probably a climacteric fruit. Antioxidant contents in terms of ascorbic acid and total phenolic contents were, however, lower with fully ripe fruits as compared to half ripe and unripe fruits. Most fully ripe fruits also had insect pest and microbial damages in pericarp and mesocarp, making them unsuitable for product development. Subsequent studies on fruit storage for medicinal products were, hence, only conducted with unripe and half ripe fruits. These fruits were short lived with refrigeration storage at $8\pm 2^{\circ}\text{C}$. Fruits packed in perforated polythene bags could be stored for only two weeks while vacuum packaging could keep the fruits for longer period of four weeks with acceptable 5% damage. Fruits exhibited lower titratable acidity and ascorbic acid content but soluble solids increased following storage in the refrigerator. There was greater loss of antioxidants in the unripe fruits as compared to half ripe fruits with cold storage. Frozen storage at -20°C enabled the fruits of unripe and half ripe stages to be stored for up to six months, with both perforated and vacuum packaging, without deleterious changes in fruit moisture and size but fruits turned duller in colour indicating freezing injuries and also became softer after thawing from sub-zero temperature storage. Antioxidants of ascorbic acid also dropped drastically while phenolics decreased gradually in both unripe and half ripe fruits with increasing freezer storage duration. For medicinal product development purposes, *Phaleria macrocarpa* fruits are best harvested at half ripe stage with consideration in terms of fruit damage, weight, size and antioxidant contents. Fruits should be processed at the soonest pace for high antioxidant content or cold stored for less than four weeks. Fruits can be preserved for longer periods of a few months at -20°C prior to product development but the antioxidants in them lost gradually with increasing storage time. Fully ripe *Phaleria macrocarpa* fruits were best for planting purposes as the embryonic axes in seeds of both unripe and half ripe fruits were not fully developed for germination purposes. The fruits should be planted in media fast or within four weeks with cold storage at $8\pm 2^{\circ}\text{C}$. With seed desiccation tolerance trial as normally applied for seed handling, seed germination dropped to 63% with moisture content of 16%. The seed can be said to have desiccation tolerance between recalcitrant and intermediate seeds. The embryonic axes could, however, tolerate further desiccation and retain 77% in vitro proliferation at lower tissue moisture content of 13.6%. In vitro conservation efforts can be planned with the embryonic axes for this medicinal plant.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Phaleria macrocarpa (Scheff.) Boerl. is a medicinal plant originated from Papua New Guinea and Irian Jaya but has been domesticated well recently in its neighbouring countries, including Malaysia. The people of Indonesia call the tree Mahkota Dewa, which literally means God's Crown (PROSEA, 1992; Saufi, 2007). This plant is found in primary and secondary forests, from the lowland up to 550 m.

Phaleria macrocarpa is a tree – shaped, long lived (perennial) plant (Plate 1.1 A). Its height ranges from 1 to 2.5 m. It has a woody cylindrical stem. The stem is brown in colour with a rough surface. It has branches budding from it. The leaves are single and short stemmed. They are dark green in colour. The leaves are ellipse to lancet shaped. Their length varies from 7 to 10 cm while the width of leaves ranges from 2 to 2.5 cm. The leaf blade is thin and pointed at the tip. The base of the leaf is flat, pinnate and smooth. The flowers appear in a group along the stems, leaves and underarms. The flower is short stemmed and crown-shaped like a tube (tubulosus) (PROSEA, 1992; Saufi, 2007; Hendra et al., 2011a). It is hermaphrodite flower with stigma at higher position and stamens at lower side within the same flower (Plate 1.1 B). The colour of the flower is white. There is, however, no documented record as whether this plant species is an outcrossing plant. The fruit is a drupe with very thin outer fruit skin of pericarp enclosing the white pulp (mesocarp), which is fibrous but watery, while the hard endocarp protects the seed in the fruit. The fruit is round to ovoid shaped, measuring 3 to 5 cm in length. The young fruit is green and the ripe becomes red (Plate 1.1 C). The seed enclosed in dark brown hard endocarp in the fruit is known to be poisonous by the locals and causes nausea if consumed. Classification of this species is as below: