UNIVERSITI PUTRA MALAYSIA

COMPARISON OF THE PROMOTER SEQUENCES OF HOMOGENTISATE GERANYLGERANYL TRANSFERASE (HGGT) FROM HIGH & LOW VITAMIN E POPULATIONS OF TANZANIAN OIL PALM (Elaeisguineensis)

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BY

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A project report submitted to Faculty of Agriculture, Universiti Putra Malaysia, in fulfillment of the requirement of PRT 4999 (Final Year Project) for award of the degree of Bachelor of Agriculture Science

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CERTIFICATION

This project report entitled Comparison of The Promoter Sequences of HomogentisateGeranylgeranylTransferase (HGGT) from High & Low Vitamin E Populations of Tanzanian Oil Palm, (*Elaeisguineensis)*is prepared by Muhammad FarisFazdhli Bin Mohd Noor and submitted to the Faculty of Agriculture in fulfilment of the requirement of PRT4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture Science.

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ABSTRACT

Oil palm is widely used in various food applicatons. Palm oil is rich in vitamin E essentialfor human consumption. Variability in the level of vitamin E exists in the oil palm germplasm materials. Tocotrienols and tocophenols are two important forms of vitamin E. In fact, tocotrienols content in *Elaeisguineensis* are higher compared to tocopherols. Tocotrienol synthesis requires homogenatisegeranylgeranyltransferase (HGGT), which catalyzes the condensation of homogentisate and the unsaturated C20 isopreoidgeranylgeranyldiphosphate (GGDP). Tocopherol differs from tocotrienol because there are three double bonds in the side chain of the tocotrienol. The aim of the study is to detect sequence variation in the form of single nucleotide polymorphism (SNP) by comparing individuals from the Tanzania population that exhibited low and high vitamin E contents. The project involves analyzing the promoter sequence and detecting for variation that falls within important promoter motifs. The genomic structures of the HGGT gene in the germplasm materials were determined. Variation in the gene structure may be exploited for developing PCR-based marker in marker assisted selection to improve vitamin E content of planting materials.

ABSTRAK

Minyakkelapasawitdigunakansecarameluasdalampelbagaiaplikasimakanan.Minyakkelapasawit kaya dengan vitamin E yang bergunauntukkeperluanmanusia.Kepelbagaiantahap vitamin E wujud di dalam material germplasmakelapasawit.Tokoferoldantokotrienoladalahduabentukpentingdalam vitamin Edimanakandungantocotrienoladalahlebihtinggiberbandingdengantocopherolsdalam*Elaeisguineensis*.Sintesistokotrienolmemerlukanhomogentisategeranylgeranyltransferase (HGGT), yang dimangkinolehpemeluwapanhomogentisatedan C20 difosfatgeranylgeranylisopreoidtaktepu (GGDP).Tocophenolsberlainandengantocotrienolkeranaterdapattigaikatankembardalamrantaiansampingantokotrienol.Tujuankajianiniadalahuntukmengesanvariasijujukandalambentuk Polimorfismenukleotidatunggal(SNP) denganmembandingkanindividudaripopulasi Tanzania yang mempamerkankandungan vitamin E yang rendahdantinggi.Projekinimelibatkanmenganalisisurutan promoter danmengesanvariasiyang terdapatdalam motif promoter penting.Strukturgenomik gen HGGT dalam material germplasmaditentukan. Perbezaandalamstruktur gen itubolehdieksploitasiuntukmembangunkanpenandaberasaskan PCR bagipemilihanpenandaberbantuuntukmemperbaikikandungan vitamin E dalambahantanaman.

CHAPTER 1

INTRODUCTION

Elaeis guineensis is a tropical forest palm native to the West and Central Africa. It has been introduced and cultivated in the humid tropics which cover from 16°N to 16°S. Another important species of oil palm is *Elaeis oleifera* (American Oil Palm) which is less planted as plantation crop compared with *E. guineensis.* The main product that can be derived from oil palm is palm oil. It can produce 3-8 times more oil in a given area than other tropical or temperate oil crops. Oil can be extracted from both the fruit and the seed, crude palm oil (CPO) from the outer mesocarp and palm-kernel oil (PKO) from the endosperm. Crude palm oil has important role in food industry especially as cooking oil and food production. Meanwhile, palm-kernal oil is used in various non-edible products, such as detergents, cosmetics, plastics, surfactants, herbicides, as well as a broad range of other industrial and agricultural chemicals.

Palm oil contains a high amount carotenoids and vitamin E was discovered mainly due to the major interest in its ability to act as antioxidant and potential to prevent atherosclerosis and cancer (Schneider,2005). Vitamin E consists of 2 major molecules which are tocopherols and tocotrienols. Tocopherol (vitamin E) is a lipid-soluble antioxidant synthesized only by photosynthetic organism (Shintani and DellaPenna,1998). Vitamin E is a natural biological antioxidant, also known to have anti-inflammatory activity, which has been extensively used to improve biostability and biocompatibility of different biomaterials (Rizzi*et al*.,2012). Compared to other vegetable oil, palm oil is the richest source of tocotrienols where the concentration in crude palm oil (CPO) is at 600-1000ppm (Terzaghi and Cashmore., 1995). This shows that palm oil has the high potential to be a good resource of vitamin E and at the same time it can increase the market value of palm oil. Vitamin E also plays a role in inhibition of platelet aggregation and neurological functions (Atkinson*et al*,2008). Then, the productivity of oil palm which has high vitamin E content needs to be increased for market demand.So, scientific research is one step to improve the content of vitamin E in the commercial oil palm in Malaysia.

There are more than 26 populations of *Elaeis guineensis* with different content of vitamin E and each of the population shows high variability in vitamin E content (Terzaghi and Cashmore., 1995). One of the *Elaeis guineensis* population that has a high diversity in its vitamin E content is the Tanzanian population. So, through discovering the variation of homogentisate geranylgeranyl transferase (HGGT) promoter sequence of *Elaeis guineensis* of the Tanzania population may help to identify the single nucleotide polymorphism (SNPs) which control the production of tocotrienols in oil palm. The first commited step for tocotrienol biosynthesis is catalyzed by HGGT hence it is a key regulatory enzyme. The gene structure of HGGT was analysed as this may help in developing molecular tools for marker assisted selection in breeding programmes.

The objective of the project were

1. To detect variation of the promoter sequence of HGGT in palms with high and low vitamin E content from Tanzanian population
2. To select for SNPs effecting important promoter motifs.

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