



UNIVERSITI PUTRA MALAYSIA

***BIOEFFICACY OF SAPONIN NANO-EMULSION FORMULATION
AGAINST *Pomacea maculata* Perry, PEST OF RICE***

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FP 2017 24

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2016/2017

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BY

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

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This project report entitled “Bioefficacy of Saponin Nano-Emulsion Formulation against *Pomacea maculata* Perry, Pest of Rice” was prepared by Azim Syahmi bin Zafri and submitted to the Faculty of Agriculture, Universiti Putra Malaysia in fulfilment of the requirement for PRT 4999 (Final Year Project) as the award of the degree in Bachelor of Agricultural Sciences.

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ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful.

Before anything else, I am grateful to Allah, the one and only Mighty God for giving me good health and wellbeing that were necessary to complete this project. Without His blessings, I am sure that I won't be able to accomplish anything.

I wish to express my sincere gratitude and appreciation to Prof. Dr. Rita Muhamad Awang, supervisor of this project for giving me the opportunity to undertake this project as well as providing me with counsel, inspiration and motivation along with all the necessary facilities needed for the research. Your office was always open for me whenever I had problems or questions regarding my project or writing.

I place on record, my wholehearted thank you and indebted to Dr. Anis Syahirah Mokhtar for sharing her expertise and valuable guidance extended to me from the beginning of this project. Without your passionate participation and input, this project could not have been successfully conducted. I am also extremely thankful to Mr. Ahmad Tamsil Shariff for his assistance and endless encouragement especially during the laboratory bioassay.

I take this opportunity to express gratitude to my parents, Mr. Zafri Ahmad Tajuddin and Mrs. Zalilah Abd Manan, also my siblings for supplying me with unfailing love and support. I am also grateful to have good friends such as Mr. Shazef Ashraf Sulaiman and Miss Yazmin Hussin. Thank you for your unceasing help. Last but not least, thank you to one and all who directly or indirectly lend their hands towards the process of completing this project.

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ABSTRACT

As the staple food in Malaysia, rice is being consumed routinely by Malaysian to provide a huge fraction of the needs for energy-rich materials. Thus, rice is planted widely all over the country. However, one of the biggest problem in growing rice is pest infestation, especially the more commonly known as apple snails, *Pomacea* spp. Apple snails bring damage by destroying rice seedlings. However, younger seedlings are more susceptible to attacks. Many methods have been adopted to control this major pest of rice. But the use of chemical molluscicide is the most favoured method by farmers due to its effectiveness. On the negative side, chemical molluscicide is hazardous to the environment, and may also jeopardize public health. In effort to create a safer alternative to chemical molluscicide, a formulation of biomolluscicide in the form of nano-emulsion was tested on Black Apple Snails, *Pomacea maculata* (Perry) to test its efficacy. The biomolluscicide was formulated using saponin, a natural glycoside extracted from plant as its active ingredient and called saponin nano-emulsion formulation. Five different treatments (2000, 1000, 750, 500 and 250 ppm) were tested including one positive and negative control. All of the treatments were replicated five times and arranged in Completely Randomized Design (CRD). MR219 rice seedlings were planted continuously to feed the apple snails. Two bioassays were conducted. The first one is the mortality bioassay. During this bioassay, mortality of apple snails were observed after 24, 48 and 72 hours. Percentage mortality of apple snail within each treatment were obtained by evaluating the data using Analysis of Variance (ANOVA). Meanwhile, feeding deterrent bioassay was also conducted to observe the mean of leaf area consumed by *P. maculata* for each treatment within 24 hours. Data of the feeding deterrent bioassay were also analysed using ANOVA. The overall result obtained proved that, saponin nano-emulsion formulation has a great potential be used as a substitute to the hazardous synthetic molluscicides for the purpose of controlling *P. maculata* in rice field.

ABSTRAK

Sebagai makanan ruji di Malaysia, nasi dimakan secara rutin oleh rakyat Malaysia untuk menjadi sumber tenaga. Oleh itu, padi ditanam secara meluas di seluruh negara. Walau bagaimanapun, masalah yang paling besar dalam penanaman padi adalah serangan perosak, iaitu siput gondang atau *Pomacea* spp. Siput gondang membawa kerosakan kepada benih padi terutamanya anak benih muda. Banyak kaedah telah digunakan untuk mengawal perosak utama padi ini. Tetapi kaedah yang paling digemari oleh para petani adalah penggunaan racun kimia kerana keberkesanannya. Namun, penggunaan racun perosak kimia adalah merbahaya kepada alam sekitar dan juga boleh mendatangkan masalah kesihatan kepada manusia. Dalam usaha untuk mewujudkan alternatif yang lebih selamat daripada racun kimia, formulasi racun botani moluska dalam bentuk nano-emulsi telah diuji ke atas siput gondang hitam, *Pomacea maculata* (Perry) untuk menguji keberkesanannya. Racun botani moluska ini telah digubal menggunakan saponin, yang mengandungi komponen semula jadi yang diekstrak daripada tumbuhan sebagai bahan aktif dan dinamakan sebagai rumusan nano-emulsi saponin. Lima rawatan yang berbeza (2000, 1000, 750, 500 dan 250 ppm) termasuk satu kawalan positif dan satu kawal negatif telah diuji. Semua rawatan telah diulang lima kali dan disusun dalam Rekabentuk Rambang Sepenuhnya (CRD). Benih padi MR219 telah ditanam secara berterusan untuk diberikan kepada siput gondang. Dua bioesei telah dijalankan. Bioesei yang pertama adalah bioesei kematian. Bagi bioesei ini, peratusan kematian siput gondang diperhatikan selepas 24, 48 dan 72 jam. Data dinilai menggunakan Analisis Varian (ANOVA). Sementara itu, bioesei 'feeding deterrent' juga telah dijalankan untuk melihat purata permukaan daun yang dimakan oleh *P. maculata* dalam tempoh 24 jam. Data diperolehi juga dianalisis menggunakan ANOVA. Keputusan keseluruhan yang diperolehi membuktikan bahawa rumusan nano-emulsi saponin mempunyai potensi yang besar untuk digunakan sebagai pengganti bagi racun sintetik berbahaya bagi tujuan mengawal *P. maculata* dalam kawasan sawah padi.

CHAPTER 1

INTRODUCTION

The modern agriculture and food industry has always been urged to keep producing more food every day. This is due to the rapid increasing of domestic and global population. The *Oryza sativa*, the scientific name for rice, is considered as the staple food in Malaysia. According to Norimah *et al.* (2008), 97% of Malaysians consumes (cooked rice) twice daily with an average of two and a half plates for each person every day. In order to fulfil the market demand for rice, the Malaysian Government had assured subsidies to the rice industry so that the supply of rice will keep increasing. However, until this day, our rice industry is still falling shortage in supply, even for domestic consumption. In context of self-sufficiency, Malaysia is currently able to produce only 72% of its total rice consumption (Christopher, 2010). The remaining 30% of the market demand is imported from major exporters of neighbouring rice producers such as Thailand, Indonesia and Cambodia (Toriman *et al.*, 2013). The local rice industry still fails to achieve 100% self-sufficiency level in rice due to a few reasons and among them are pests and diseases. The outrage of rice pests especially *Pomacea* spp. (apple snails) has been an unsolved problem which needs serious attention.

In Malaysia, there are two species of apple snails which have been found infesting rice fields all over the country. They are *Pomacea canaliculata* and *Pomacea maculata*. These molluscs have become a big problem for local rice producers since the 90's after being brought in from their native countries. During their early introduction, *Pomacea* spp. is a commodity which is much appreciated and traded all over the world (Halwart, 1994; Cowie, 2002). They were initially hyped as potential protein suppliers and valuable aquarium animals. However, when people had started to realise their commercial value is zero in addition to their non-suitability for human consumption due to horrible taste, the apple snails were then expelled to the local surroundings. According to Cowie (2002); Estebenet and Martin (2002), apple snails

can survive and reproduce in many conditions, disregarding its favourability. The apple snails were believed to be surviving Malaysia's environment due to this trait, infesting huge areas of rice fields. According to Yahaya *et al.* (2006), apple snails have invaded more than 17 000 hectares of rice fields in our country.

In the efforts to prevent the infestation by apple snails from becoming more serious, many control methods have been deployed. Among them are cultural, biological and chemical controls. But the most favoured and applied control method is the chemical control. This is because it comes with a low cost. Local rice producers love using chemical molluscicide such as niclosamide, metaldehyde and methiocarb because of its effectiveness in controlling the population of the apple snails. However, the usage of chemical molluscicides has become a concern as it can bring harmful effects to human and the environment due to its toxicological properties. One of the options in preventing further usage of chemical molluscicide is by substituting it with botanical molluscicide. Botanical molluscicides are natural-occurring chemicals which are toxic to molluscs, obtained from the extraction of plants or minerals. It is a good practice to utilise the botanical molluscicides as it is friendlier to the environment.

Saponin is a type of chemical compound found in various plant species. It functions as a barrier towards pathogen attack in the plant defense system (Augustin *et al.*, 2011). Besides that, saponin was also found to possess high toxicity level against molluscs (Sindambiwe *et al.*, 1998). Consequently, the main objective of this experiment is to minimize the population of apple snail and it can be achieved through these sub-objectives. They are:

1. To investigate the efficacy of saponin nano-emulsion formulation against *P. maculata*.
2. To evaluate the feeding deterrent activity of saponin nano-emulsion formulation against *P. maculata*.

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