การศึกษาสารเคมีกำจัดแมลง กลุ่มออร์กาโนฟอสเฟต และ คาร์บาเมต ในสมุนไพรฟ้าทะลายโจร ที่วางจำหน่ายในท้องตลาด

กัญภร เกื้อศิริกุล

สารนิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรวิทยาศาสตรมหาบัณฑิต
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ปีการศึกษา 2566

A STUDY OF ORGANOPHOSPHATE AND CARBAMATE PESTICIDE RESIDUES IN COMMERCIALLY AVAILABLE ANDROGRAPHIS PANICULATA PRODUCTS

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ใบรับรองสารนิพนธ์

วิทยาลัยการแพทย์บูรณาการ มหาวิทยาลัยธุรกิจบัณฑิตย์

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หัวข้อสารนิพนธ์	การศึกษาสารเคมีกำจัดแมลง กลุ่มออร์กาโนฟอสเฟต และ คาร์บาเมต ในสมุนไพรฟ้าทะลายโจร ที่วางจำหน่ายในท้องตลาด
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วันที่ 12 เดือน 6 พ.ศ. 67

หัวข้อสารนิพนธ์	การศึกษาสารเคมีกำจัดแมลง กลุ่มออร์กาโนฟอสเฟต และคาร์บาเมต ในสมุนไพรฟ้าทะลายโจร ที่วางจำหน่ายในท้องตลาด
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ปีการศึกษา	2566

บทคัดย่อ

การศึกษาครั้งนี้เป็นการศึกษาเพื่อหาสารกำจัดศัตรูพืชตกค้าง กลุ่มออร์กาโนฟอสเฟตและคาร์บาเมต ในผลิตภัณฑ์ฟ้าทะลายโจรในรูปแบบแคปซูล โดยผู้วิจัยได้ทำการสุ่มเลือกผลิตภัณฑ์ทั้งสิ้นจำนวน 30 ตัวอย่าง ประกอบไปด้วย 10 ตัวอย่างจาก Lazada, 10 ตัวอย่างจาก Shopee และ 10 ตัวอย่างจาก ท้องตลาด โดยใช้ชุดทดสอบ GPO-TM Kit และ Mahidol Pest Easy Test ที่ได้รับการรับรองมาตรฐานจาก กระทรวงสาธารณสุขแห่งประเทศไทย เป็นเครื่องมือในการตรวจสอบ โดยชุดทดสอบ GPO-TM Kit ใช้หลักการแยกสารด้วยวิธีทีแอลซี (TLC) และตรวจสอบด้วยการทำปฏิกิริยากับสารเคมีเพื่อให้เกิดสี หากพบสารเคมีกำจัดแมลงจะเกิดแถบวงกลม (Spot) บนแผ่นทีแอลซี และ สำหรับชุด ทดสอบ Mahidol Pest Easy Test หากพบจุดสีฟ้า แปลว่าตัวอย่างนั้นปลอดภัย หากพบสีฟ้าอ่อน จะแปลว่าอันตรายเล็กน้อย หากพบจุดสีขาวจะแปลว่าอันตรายอย่างมาก ผลสรุปมีดังนี้ จากผลการตรวจด้วยชุด GPO-TM Kit นั้น ทั้ง 30 ตัวอย่าง (ร้อยละ 100) และ จากชุด Mahidol Pest Easy Test 23 ตัวอย่าง (ร้อยละ 76.6) พบว่ามีสาร กำจัดศัตรูพืชตกค้าง ซึ่งสรุปได้ว่า ปัญหาสารเคมีกำจัดศัตรูพืชปนเปื้อนในพืชผลทางการเกษตรและสิ่งแวดล้อม ยังคงเป็นหนึ่งปัญหาสาธารณสุขที่สำคัญของประเทศไทย งานวิจัยชิ้นนี้ จึงทำขึ้นเพื่อให้ผู้บริโภคสามารถเข้าถึงองค์ความรู้นี้ และนำไปใช้ในการเลือกบริโภคผลิตภัณฑ์ฟ้าทะลายโจรในรูปแบบแคปซูล อย่างระมัดระวังยิ่งขึ้น

คำสำคัญ : ออร์กาโนฟอสเฟต, คาร์บาเมต, ฟ้าทะลายโจร, GPO-TM Kit, Mahidol Pest Easy Test

Thematic Paper Title	A STUDY OF ORGANOPHOSPHATE AND CARBAMATE PESTICIDE RESIDUES IN COMMERCIALLY AVAILABLE ANDROGRAPHIS PANICULATA PRODUCTS
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Program	Master of science (Anti-Aging and Regenerative Medicine)
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ABSTRACT

This paper researches the presence of organophosphate and carbamate pesticide residues in commercially available *Andrographis Paniculata* capsule products. Thirty *A. Paniculata* capsule products were randomly selected from 3 sources. Ten products from Lazada, 10 from Shopee, and 10 from local markets. To conduct the screening test, the GPO-TM Kit and Mahidol Pest Easy Test, which are approved by The Thai Ministry of Public Health, are utilized. The principle of the GPO-TM kit is the separation of chemical compounds using the Thin Layer Chromatography (TLC) method. If pesticides are detected, there will be a white circle on the TLC sheet. For the Mahidol Pest Easy Test, a blue spot indicates that the sample is safe, light blue if it is slightly hazardous, and white if it is highly hazardous. Using the GPO-TM Kit, organophosphate and carbamate residues were detectable in 30 samples (100%). However, that of the Mahidol Pest Easy Test was 23 samples (76.6%). It can be implied that pesticide contamination in agriculture and the environment continues to be one of the major public health problems in Thailand. Thus, this research intends to make this information easily accessible from a public concern perspective so consumers can use this information to be more careful in choosing to consume Fah Talai Jone capsule products more safely.

Keywords : organophosphate, carbamate, *Andrographis Paniculata*, GPO-TM Kit, Mahidol Pest Easy Test

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Kanyaporn Kuesirikul

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CHAPTER 1
INTRODUCTION

1.1 Background of the Study

This research investigates pesticide residues in a popular Thai Traditional Medicine (TTM) product – Fah Talai Jone (*Andrographis paniculata*). Pesticides are widely used around the world, with one estimate suggesting global usage of up to two million tonnes a year[1]. In Thailand, agriculture is a significant sector of the economy, employing up to 30% of the population and contributing strongly to the economy of rural regions[2]. It is unsurprising that there is a high use of pesticides, particularly insecticides and herbicides, as shown in Figure 1[2]. High use of pesticides is a concern for agricultural workers due to the risks of direct exposure, as pesticides are associated with neurotoxicity[2]. Research has also repeatedly shown that pesticide residues remain on domestically produced produce[2–5]. This raises the question of whether pesticide residues are present in medical products such as Fah Talai Jone.

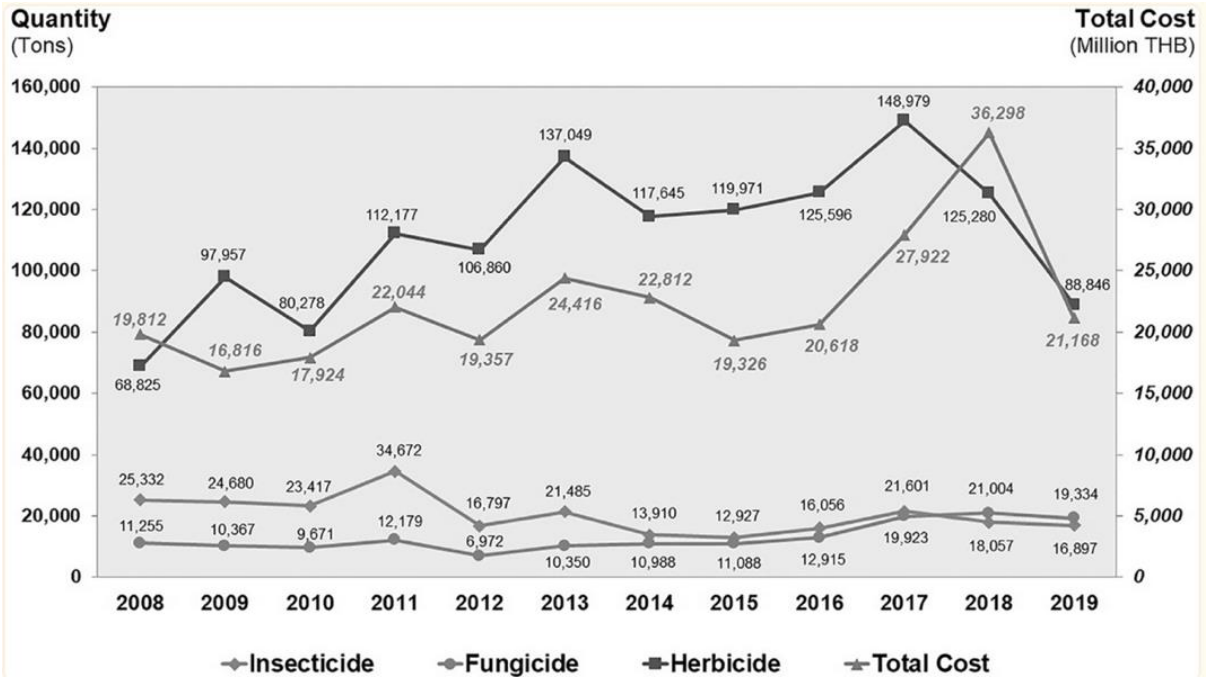


Figure 1.1 Pesticide imports to Thailand (2008 to 2019)[2]

1.2 Research Question

Is there evidence of organophosphate and carbamate pesticide residue in commercially available Fah Talai Jone products?

1.3 Objective of the Study

The research objective is to investigate carbamate and organophosphate pesticide residues in commercially available Fah Talai Jone products. Objectives of the study include: Conducting analysis of commercially available Fah Talai Jone products to investigate evidence of organophosphate and carbamate pesticide residues.

1.4 Research Hypotheses

There is detectable organophosphate and carbamate residues in commercially available Fah Talai Jone.

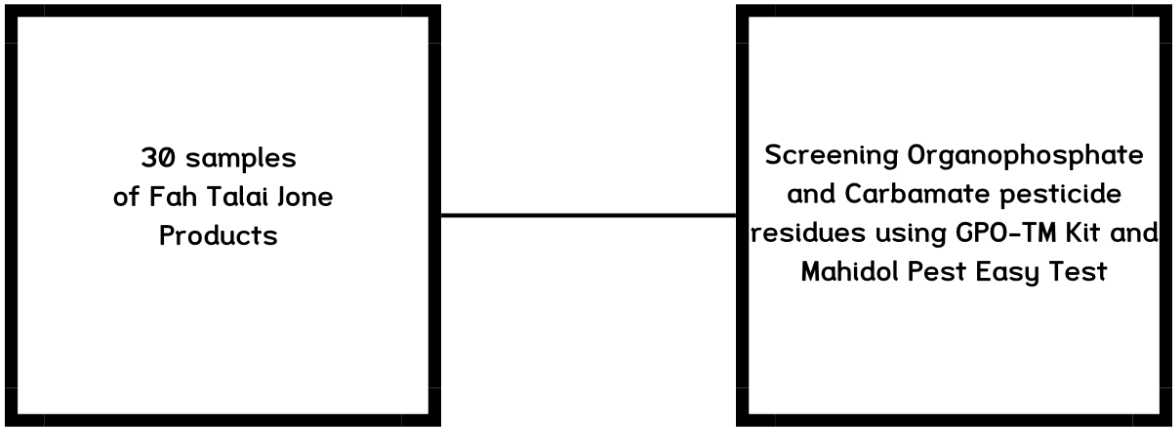
1.5 Scope of Research

The research analyzes the presence/absence of organophosphate and carbamate residues in 30 commercially available Fah Talai Jone products using the GPO-TM Kit and Mahidol Pest Easy Test.

1.6 Purpose of the Study

To raise awareness on pesticide contamination in commercially available Fah Talai Jone products.

1.7 Conceptual Framework



1.8 Definition of Terms

1.8.1 Pesticide

Pesticides are substances that control organisms (insects, fungi, plants, slugs, snails, weeds, micro-organisms, nematodes, etc.) which destroy plant life and interfere with the food chain, and which act as vectors for disease organisms to man and animals[6].

1.8.2 Fah Talai Jone Products

Fah Talai Jone products employed in the research come in two forms, namely capsules and tablets. They are purchased from Lazada, Shopee, and local markets. Some products included in this study are FDA registered while some are not.

Chapter 2

Literature Review

2.1 Introduction

The objective of this study is to investigate organophosphate and carbamate in commercially available Fah Talai Jone products. The purpose of the literature review is to establish existing knowledge on pesticides in general and pesticide contamination in Thai agricultural products. The chapter begins with an overview of Fah Talai Jone. It then continues with a discussion of pesticides, providing a brief definition and review of chemical typology and toxicological classifications of pesticides. Biological effects of pesticides in humans and other animals are also discussed here. The second section of the chapter reviews empirical studies that have investigated pesticide residues in Thai traditional medicines and agricultural products.

2.2 Plant Description

Andrographis paniculata (Burm.f.) Wall. ex Nees, known in Thailand as Fah Talai Jone, is a member of the Acanthaceae family[7]. The plant is native to India and Sri Lanka, and is cultivated throughout China, Southeast Asia, and several other regions. This plant typically grows to approximately 30 to 100 centimeters in height, with square, smooth stems, and ovate leaves (Figure 2.1)[8].

Figure 2.1 Morphological characteristics of *Andrographis paniculata*.
(A): aerial part,
(B): fruits and flowers, (C): close-up of the flower, and (D): fruits[8]

Fah Talai Jone is a traditional medicine seen in many cultures, including Traditional Chinese Medicine (TCM), Ayurvedic Medicine, and Thai Traditional Medicine. It is commonly used to treat different ailments like the common cold, fever, sore throats, and diarrhea since the early times[9]. Its valuable anti-inflammatory, anti-microbial, and anti-infective properties are derived from the diterpene lactone compound, Andrographolide, present in the plant[10]. Thus, Fah Talai Jone is a highly useful source of drugs against pressing problems, such as the COVID-19 pandemic, today.

2.3 Fah Talai Jone Forms and Dosage

Today it is common to use formulations that deliver Fah Talai Jone as capsules or powder, which may be dissolved in water or taken on its own. Such formulations provide added ease and public accessibility to self-treat. It is important to note that andrographolide concentrations vary depending on the preparation and source, and concentrations are not always listed on the product packaging. However, the recommended dose of andrographolide powder to address health concerns such as respiratory diseases is 144 mg to 180 mg per day, usually delivered across three doses in a day[11]. Furthermore, because Fah Talai Jone products are high in demand, the production process is compromised, leading to many products being contaminated, adulterated, or even fake[11]. There is little research that analyzes pesticide residues in Fah Talai Jone, which is why this research is significant and relevant to the current world situation.

2.4 Pesticides

Pesticides can be defined broadly as “substances that control organisms (insects, fungi, plants, slugs, snails, weeds, micro-organisms, nematodes, etc.) which destroy plant life and interfere with the food chain, and which act as vectors for disease organisms to man and animals”[6]. Commercial pesticides, beginning with copper fungicides, entered agricultural practice in the 1880s, with organic pesticides being produced commercially from the 1930s[6]. While most pesticides applied to crops are removed during cultivation and processing, it is possible that there could be traces of pesticides present in varying amounts in consumer products[12]. These residues cannot be detected by consumers, and only some residues can be removed. Thus, understanding pesticide residues is key for protecting consumer health.

Pesticides can be classified based on their chemical structure and origin or based on their biological effects. Both classifications are discussed below.

2.4.1 Chemical structure typology of pesticides

There are four major classes of pesticides, which have different chemical structures, derivations, and effects[6]. These four groups include organophosphates, carbamates, pyrethrins and organochlorines.

(1) Organophosphates

Organophosphate pesticides, also called organophosphorus compounds, were one of the first classes of modern pesticides, with development beginning as early as in the 1930s[13]. They are typically used for protection against insects and are among the most widely used pesticides around the world. There are 13 different types of organophosphate pesticides, with each having a slightly different chemical structure[14]. However, they have similar mechanisms, as they mainly function as acetylcholinesterase (AChE) inhibitors[15]. As AChE functions as a catalyst for the neurotransmitter acetylcholine, AChE inhibitors like organophosphates have the effect of breaking down neurological function[15]. Human exposure to organophosphates can have serious effects (Figure 2.2), although the severity depends on exposure and duration[16-17]. These effects, which can range from mild effects like headaches and nausea, to long-term health problems and even death, are most likely to affect farmers who work directly with organophosphates. While organophosphate residues in food are usually low, they do pose a similar risk if consumed[18].

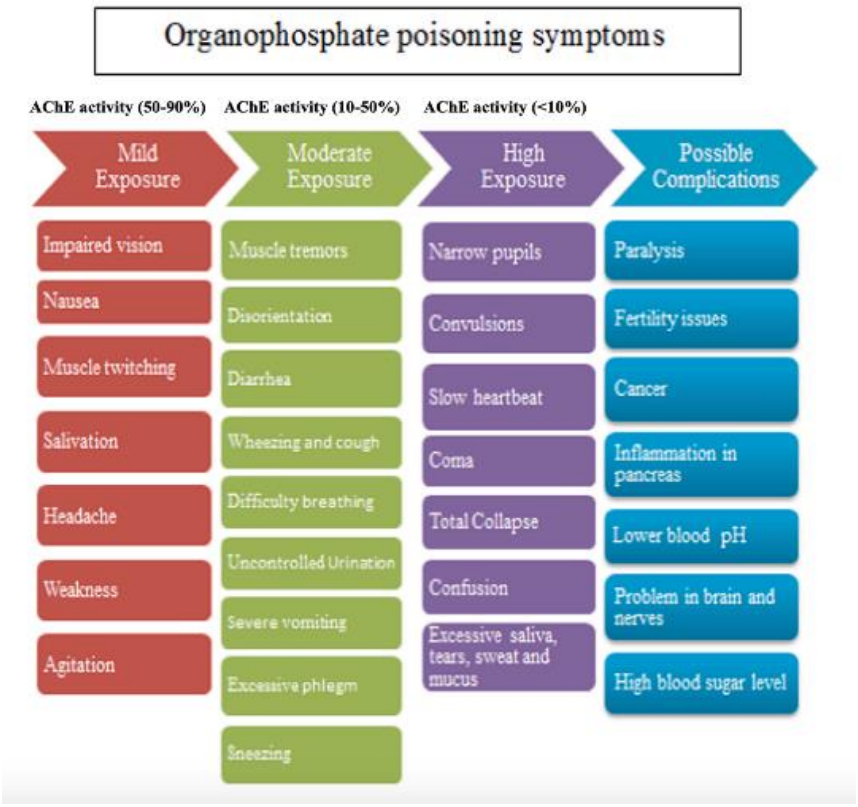


Figure 2.2 Acute effects of organophosphate poisoning[17]

(2) Carbamates

Carbamate pesticides, which are commonly used as insecticides, are esters of carbamic acid[19]. The general structure of carbamates is shown in Figure 2.3. Like organophosphates, carbamates function as AChE inhibitors, meaning that acute and prolonged exposure can have neurological effects on the body[19]. Furthermore, as carbamates bond to acetylcholine transmitters, this effect is non-reversible[20]. Acute exposure to carbamates can have effects ranging from hypersalivation to seizures and death, depending on the extent of exposure[19]. Such effects are usually short-lived, resolving within 24 hours[20]. However, even with mild exposure, carbamates can attack the immune system, causing long-term effects ranging from increased allergen sensitivity to predisposition to some forms of cancer[21]. Like organophosphates, most acute carbamate toxicity cases are farmers exposed to the chemicals[19]. However, carbamate residues are also commonly found on fruits and vegetables at rates exceeding international standards, which does pose significant risks for consumers in the long term. However, these risks have not been adequately assessed in most populations[22].

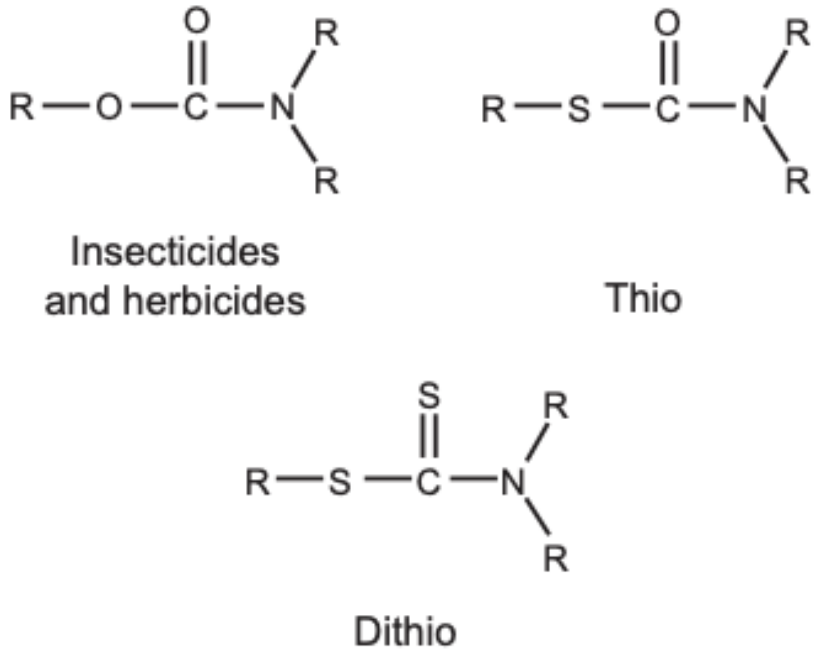


Figure 2.3 The general structure of carbamate pesticides[19]

(3) Pyrethrins

The third class of pesticides is pyrethrins, which are used as insecticides[23]. Pyrethrins, whose general structure is shown in Figure 2.4, are derived from protective compounds synthesized by plants in the Pyrethrum genus. The acute toxicity of plant-derived pyrethrins is typically low, which is why they are commonly used in organic farming[23]. However, pyrethrins can persist in soil and water, and the toxic effects of chemically synthesized pyrethrins on humans could supposedly be more severe[24]

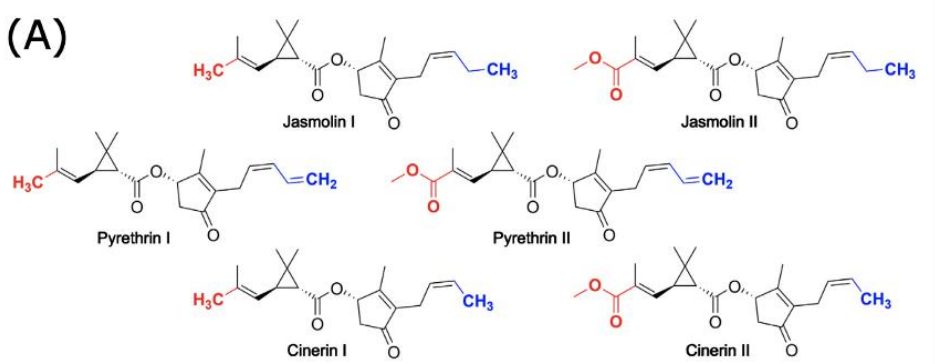


Figure 2.4 The structure of common pyrethrins[23]

(4) Organochlorines

Organochlorine pesticides, which are chlorinated compounds (as shown in Figure 2.5), are among the cheapest and most widely used insecticides[25]. Although as of the early 2000s organochlorines were around 40% of pesticides used by volume, many common pesticides in this category have been removed from the market[26]. The removal of organochlorines from the market has been driven by the growing recognition that these chemicals persist and build up in soil and water, a problem which is challenging to remediate[27]. Despite this, organochlorines still have the potential to impact human health through various endocrine disruption mechanisms[25].

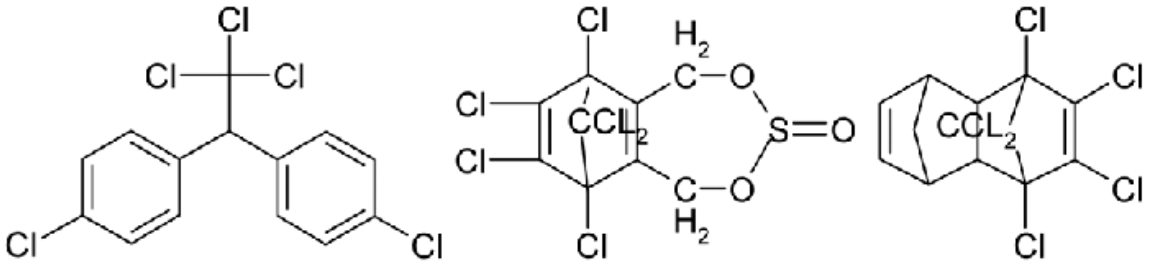


Figure 2.5 The chemical structure of some organochlorine pesticides[25]

2.5 Toxicological classification

The World Health Organization (WHO) classifies pesticides by toxicological effects, with five categories as shown in Figure 2.6. These classifications, which are based on animal testing (usually sourced from the manufacturer), include oral and dermal toxicity for all forms of the pesticide.

WHO Class	Category	LD_{50} for the rat (mg/kg body weight)	
		Oral	Dermal
Ia	Extremely hazardous	< 5	< 50
Ib	Highly hazardous	5–50	50–200
II	Moderately hazardous	50–2000	200–2000
III	Slightly hazardous	Over 2000	Over 2000
U	Unlikely to present acute hazard	5000 or higher	

Figure 2.6 The World Health Organization (WHO) pesticide classification criteria[29]

2.6 Related Studies

There have been several studies that have investigated organophosphate and carbamate residues in Thai agricultural products. While the following reviews do not focus on Fah Talai Jone, they do establish the scope of the problem and what may be found in the primary research.

Suntudrob and team conducted a study establishing a baseline for presence of pesticide residues in Thai agricultural products. This paper reported on a Ministry of Public Health monitoring program, in which samples of typical vegetables (ivy gourd, yardlong bean, water spinach, and Chinese broccoli) (n = 934) were collected from provincial wholesale markets around the country. Multi-residue extraction and gas chromatography were used to measure residues of 60 different pesticides. Among the samples, 22.3% were found to have residue of at least one pesticide, with Chinese broccoli and ivy gourd having the highest residues[4].

Namvong & Chongrattanameteekul investigated sweet basil produced conventionally and organically (n = 360) which found residues of three different organophosphate chemicals on 25.8% of samples, including conventional and organic samples. While most samples were below the European Union's Maximum Residue Limits (MRL), a total of 11 samples had residues of two of the pesticides that were above this level[3].

A more recent study conducted by Wittayanan & Chaimongkol used gas chromatography and mass spectrometry (GC-MS) to investigate pesticide residues in cannabis. The authors investigated 85 samples, including 122 possible pesticides, and identified eight different pesticides, predominantly organophosphates and carbamates. Most of the samples (81.2%) were found to have residues of at least one pesticide. The authors did identify a few samples above MRL, but most were below. This study is particularly useful because it is one of the few studies that have focused on non-food crops, and it suggests that the rate of pesticide residues may be higher among non-food crops[28].

Wanwimolruk and team investigated three commonly eaten fruits, using GC-MS to investigate pesticide residues. The authors sampled bananas, pineapples, and dragon fruit, testing both peeled and unpeeled samples for 85 different pesticide residues. They found that residues were very high in unpeeled pineapples and dragon fruit (96%), but lower in bananas (26%). They also found that most of the unpeeled samples exceeded MRL[5].

Another recent study published by Naksen and team used gas chromatography-flame photometric detector (GC-FPD) to evaluate organophosphate residues on samples of 12 different vegetables from local markets in Northern Thailand (n = 1136). The authors looked for residues of 19 common organophosphates. Fifty-seven point two percent of the sample did not have detectable residues, but the remainder had between one and six organophosphate residues. While most residues did not exceed MRL, residues of chlorpyrifos, dimethoate, and parathion-methyl were above MRL in between 6% and 20% of different sample groups (Figure 2.7). This shows that as with the older studies, pesticide residues are commonplace, although most do not exceed MRL[29].

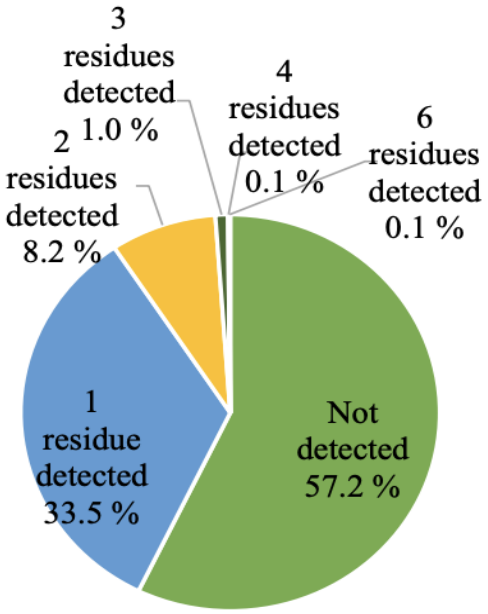


Figure 2.7 Proportion sample of organophosphate residues detected[29]

Chapter 3
Methodology

3.1 Introduction

This chapter proposes an outline of research methods that the researcher followed to explore the presence of organophosphate and carbamate pesticide residues in Fah Talai June medicine. The first section provides information on the inclusion criteria and how the samples were selected. The second section describes the research design that was chosen for the purpose of this study. The procedures that were followed to carry out this study are also included.

3.2 Sample Materials

Since little to no literature has described the possible organophosphate or carbamate pesticide contaminants that are present in Fah Talai Jone products, this investigation would bridge this gap of knowledge. The objective of study is to analyze and present quantitatively the presence/absence of organophosphate or carbamate pesticide residue in Fah Talai Jone samples. Ten commercially available Fah Talai Jone products were purchased as samples from three different sources: Lazada and Shopee, and local markets. The total number of samples is 30. This lab study was conducted at the College of Integrative Medicine, Dhurakit Pundit University.

3.3 Inclusion Criteria

The researcher has included a total of 30 Fah Talai Jone product samples, purchased at random from Lazada, Shopee, and local markets. 20 samples were bought from Lazada and Shopee. It is required that the product has an overall rating of 4.8/5 stars and had been purchased over 1000 times. For the remaining 10 products, the researcher purchased them from licensed retail pharmacies.

3.4 GPO-TM Test Kit

3.4.1 Preparation and Extraction

(1) Added 0.5 grams of finely powdered Fah Talai Jone samples in each bottle with 5 ml of extraction solution by following instructions and labeled each bottle.

(2) Added approximately 0.25 grams (~ 1 capsule) of charcoal powder into each sample bottle from 1. Shaked each bottle for 1 minute and left them for another 5 minutes to obtain complete extraction of a clear liquid layer.

(3) Used a plastic dropper to draw 1 milliliter of clear layer extract in 2. into a metal cup on the rack of warm water bath and left it at 48°C until the solution is almost fully evaporated (2-3 drops left).

3.4.2 Testing Procedure

(1) Labelled names of samples to be tested on the upper end of GPO-TM/1 TLC sheet.

(2) Used a capillary tube to draw extract from 1. and leaned the cup from side to side to dissolve the dried substance. Spotted extract from capillary tip on the spot point (at the bottom end) on GPO-TM/1 TLC sheet once, then raised the capillary up and waited for it to air dry, then repeated this process for another 4-6 times until the extract in the capillary is finished.

(3) Used forceps to pinch the GPO-TM/1 TLC sheet into the TLC tank and gradually leaned it against the inner wall. Closed the tank cover to let the solution diffuse upwards until it reached the solvent front line. Then, the sheet was taken out and left to air dry. Sprayed Testing Solution 1 over GPO-TM/1 sheet used forceps to lay the sheets facing up on a warm water bath at 37°C, covered with a tray for 10 minutes to obtain constant temperature.

(4) After 10 minutes, Color Testing Solution (prepared by mixing 1 ml of GPO-TM 1 Solution and 4 ml of GPO-TM 2 Solution from above) was sprayed on the TLC sheet and left for 3 minutes to interpret the results.

3.4.3 Result Interpretation

If a white rounded spot is detected in the same spot as that of methomyl, the positive control, on the purple background on the GPO-TM/1 TLC sheet, it can be concluded that there are organophosphate and carbamate residues in the sample. The retention factor (Rf) is 0.67. If no white rounded spot is detected on the purple background on the TLC sheet, it can be concluded that the sample contains no organophosphate and carbamate residues.

3.5 Mahidol Pest Easy Test

3.5.1 Testing Procedure

(1) Finely chopped Fah Talai Jone samples. Used plastic forceps to pinch 1 gram of the homogenous sample into sample bottle A.

(2) Inserted the filter lid. Shaked bottle A well for 1 minute and let sit for another 10 minutes.

(3) Added solvent 1 from bottle A into the right well (R) with a plastic strip. Let sit for 10 minutes for a chemical reaction.

(4) Pulled out the plastic strip and add 2 drops of solvent B into the left well (L). Set the timer for 20 minutes.

(5) Interpreted the results by comparing it to the control test kit.

3.5.2 Preparation of Control Kit

(1) Added 1 drop of solution from the control bottle into well A of the rapid test device. Let sit for 10 minutes for a chemical reaction. Used forceps to pinch 1 gram of the homogenous sample into sample bottle A.

(2) Pulled out the plastic strip and added 1-2 drops of solution from bottle B into the left well (L). Let sit for another 20 minutes.

(3) After 20 minutes was up, observed the results in the right well (R) in comparison Figure 3.3

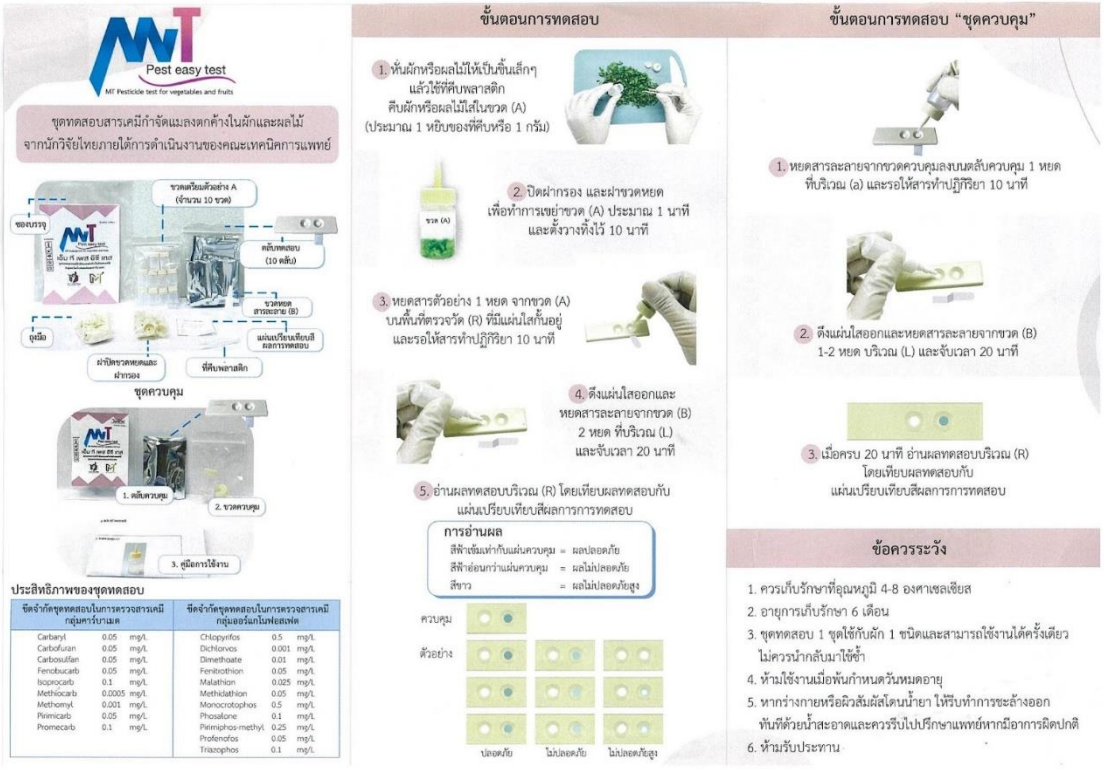


Figure 3.1 Mahidol Pest Easy Test instruction sheet[31]

3.5.3 Result Interpretation

Dark blue = safe

Light blue = slightly hazardous

White = highly hazardous

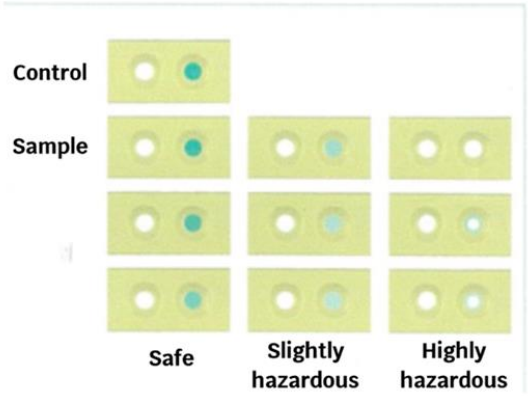


Figure 3.2 Result interpretation instruction sheet[31]

3.6 Data analysis

Results from both test kits are discussed to provide accurate analysis of each sample.

Chapter 4

Results

4.1 Introduction

30 different commercially available Fah Talai Jone products were selected at random from three locations, namely Lazada, Shopee, and local markets to undergo preliminary organophosphate and carbamate pesticide toxicity screening. Medicinal plants such as Fah Talai Jone are commonly taken in the form of capsules due to ease of administration, which is why the samples included were all in capsule format. Each sample was attentively tested using two different test kits: the GPO-TM Kit and Mahidol Pest Easy Test.

4.2 Table of Test Results

Table 4.1 shows that using the GPO-TM Kit, 30 samples tested positive (100%) by comparing with Methomyl, where a white rounded spot is detected on the purple background on the GPO-TM/1 TLC sheet, which can be concluded that there are organophosphate and carbamate residues in the samples. Using the Mahidol Pest Easy Test, 23 samples tested positive (76.6%), where the spot is identical to that of the control kit.

Table 4.1 Organophosphate and carbamate screening results of 30 Fah Talai Jone samples

No.	Fah Talai Jone Brand	Source	GPO-TM Kit Results	Mahidol Pest Easy Test Results
1	Abhaibhubejhr	Lazada	+	Safe
2	Yanhee	Lazada	+	Slightly hazardous
3	Herb Thai Jong	Lazada	+	Slightly hazardous
4	Ouay Un Osot	Lazada	+	Highly hazardous
5	Giffarine	Lazada	+	Safe
6	VitalKlares (blister pack)	Lazada	+	Highly hazardous
7	อภัยแอนโดร Abhai Andro	Lazada	+	Slightly hazardous
8	Karaboon	Lazada	+	Safe
9	Phuluang Herbs	Lazada	+	Safe
10	Fa Tha Lai Chon Capsules	Lazada	+	Safe
11	Khaolaor (blister pack)	Shopee	+	Slightly hazardous
12	Phuluang Herb	Shopee	+	Safe
13	Fa Tha Lai Chon Capsules	Shopee	+	Slightly hazardous
14	Phukon Herb	Shopee	+	Safe
15	Ouay Un Osot (blister pack)	Shopee	+	Safe
16	No brand (in clear sealed pack)	Shopee	+	Safe
17	Ma Mangkorn Yiab Dow	Shopee	+	Safe
18	Thongek Brand	Shopee	+	Slightly hazardous
19	Thanyaoporn Herbs	Shopee	+	Safe

Table 4.1 (Cont.)

No.	Fah Talai Jone Brand	Source	GPO-TM Kit Results	Mahidol Pest Easy Test Results
20	CK Natural Herbs	Shopee	+	Safe
21	Karaboon (small blister pack)	Local market	+	Safe
22	KMP	Local market	+	Slightly hazardous
23	Abhaibhubejhr (blister pack)	Local market	+	Safe
24	Sand-M	Local market	+	Slightly hazardous
25	Lamthong Karnpat	Local market	+	Slightly hazardous
26	SiamHerbal	Local market	+	Safe
27	PhytoCare	Local market	+	Safe
28	Khaolaor (bottle)	Local market	+	Slightly hazardous
29	Ajarn Panthep and Dr. Wear	Local market	+	Safe
30	Charoenwatrs	Local market	+	Safe

+ = Detected

Chapter 5
Discussion and Conclusion

This study investigated the presence of organophosphate and carbamate pesticide residues in Fah Talai Jone products, which are commonly used to treat illnesses such as colds and fevers. This supplement became increasingly popular during the COVID-19 pandemic due to its antimicrobial properties. Due to this, the demand for Fah Talai Jone products skyrocketed, meaning adulterated and contaminated products became a widespread occurrence. This research involved the random selection of 30 commercially available Fah Talai Jone products, which were purchased from online marketplaces Lazada and Shopee, local markets. Initial screening tests were conducted using the GPO-TM Kit and Mahidol Pest Easy Test. The researcher has chosen to utilize standardized test kits as a feasible way to rapidly detect pesticide residue in Fah Talai Jone products and promote food safety.

5.1 Discussion

The purpose of this study was to raise awareness on pesticide contamination in commercially available Fah Talai Jone products. This was achieved by selecting 30 samples to undergo thorough testing to identify possible pesticide residue. The results from the two different test kits used differed slightly. Using the GPO-TM Kit, organophosphate and carbamate residues were detectable in 30 samples (100%). However, that of the Mahidol Pest Easy Test was 23 samples (76.6%). The statistics are relatively concerning. As the literature review in Chapter 2 discussed, there has been little prior research into pesticide residues in Fah Talai Jone products. This is an interesting point, as there have been reports regarding the widespread findings of counterfeit and adulterated Fah Talai Jone in the market due to its popularity and as a result of poor regulation of herbal supplements[11]. The aforementioned results second this statement and this research has indicated that there may be a further danger to the consumption of Fah Talai Jone, which is the high level of pesticide residue that could potentially pose long-term health impacts to users.

The GPO-TM Kit and Mahidol Pest Easy Test can only provide initial screening test result. Thus, residues with small concentrations cannot be precisely measured. These concentrations are said to be below the limit of detection (LOD), shown in Table 5.1 and Table 5.2.

Table 5.1 Standard in Pesticide Detection of organophosphates and carbamates[32,33].

Name of Standard Substances	**Limit of Detection in vegetables, fruits, and grains (LOD ; mg/kg)**
Organophosphates	
Chlorfenvinphos	0.14
Chlorpyrifos	1.9
Diazenon	9.4
Dichlorvos	0.05
Dicrotophos	0.13
Monocrotophos	0.24
Profenofos	0.56
Carbamates	
Bendiocarb	0.69
Carbaryl	3.2
Carbofuran	0.10
Methomyl	0.39

Table 5.2 Limit of Detection (LOD) of the Mahidol Pest Easy Test[31]

Name of Standard Substances	**Limit of Detection in vegetables, fruits, and grains (LOD ; mg/kg)**
Organophosphates	
Chlopyrifos	0.5
Dichlorvos	0.001
Dimethoate	0.01
Fenitrothion	0.05
Malathion	0.025
Methidathion	0.05
Monocrotophos	0.5
Phosalone	0.1
Primiphos-methyl	0.25
Profenofos	0.05
Triazophos	0.1
Carbamates	
Carbaryl	0.05
Carbofuran	0.05
Carbosulfan	0.05
Fenobucarb	0.05
Isoprocarb	0.1
Methiocarb	0.0005
Methomyl	0.001
Pirimicarb	0.05
Promecarb	0.1

5.2 Conclusion

In conclusion, this research has identified a potentially serious issue with Fah Talai Jone, a popular traditional medicinal product in Thailand, which is the presence of organophosphate and carbamate residues. Because the production and distribution of Fah Talai Jone products and herbal supplements have conveniently gone under the radar, there has yet to be a clear way to address this problem in a practical way. More research needs to be done in terms of identifying precise residue levels in such Fah Talai Jone products and how to minimize them. To finalize, these findings are suggestive that further research would be needed to fully understand the degree of pesticide contamination in herbal medicines like Fah Talai Jone.

5.3 Suggestions

5.3.1 Suggestions from conducting this research.

One of these limitations was the use of the GPO-TM Kit and Mahidol Pest Easy Kit for evaluating pesticide residues. While these tests detect the presence of pesticide residues, they do not quantify the pesticide residue levels or identify specific pesticides that are present. It is also possible that there were samples with small concentrations that did not reach the Limit of Detection. Using the GPO-TM Kit, organophosphate and carbamate residues were detectable in 30 samples (100%). For the Mahidol Pest Easy Test, 23 samples (76.6%) tested positive.

5.3.2 Suggestions for future research

To obtain more detailed qualitative data, higher precision techniques to investigate pesticide residues on produce should be considered. For example, different studies have used a more reliable and robust method, such as gas chromatography-mass spectroscopy (GC-MS) to investigate pesticide residues on Thai traditional vegetables[5,28]. Therefore, there is an opportunity to investigate Fah Talai Jone pesticide residues in more detail by applying such analysis techniques, which can provide quantitative information about the exact type of pesticide contamination and the level of pesticide contamination.

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ประวัติผู้เขียน

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ประวัติการศึกษา

พ.ศ. 2564 - อักษรศาสตร์บัณฑิต (หลักสูตรนานาชาติ) สาขาวิชาภาษาและวัฒนธรรม จุฬาลงกรณ์มหาวิทยาลัย

ประสบการณ์ทำงาน

พ.ศ. 2566 - พนักงานต้อนรับบนเครื่องบิน สิงคโปร์แอร์ไลน์

พ.ศ. 2565 - แอดมินแผนกบริหารการศึกษา โรงเรียนนานาชาติบรอมส์โกรฟ วิทยาเขตประถมและมัธยมศึกษา สนามกอล์ฟวินด์เซอร์