

**An-Najah National University**

**Faculty of Graduate Studies**

**Pesticide Residues in Imported Sweet Peppers,  
Tomatoes and Grapes in the North West Bank**

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and grapes in the north West Bank**

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## **Dedication**

To my beloved parents and brothers.

To my lovely daughter Eleen.

To my family, friends and everyone who supported me.

## **Acknowledgment**

In the beginning, I thank God ""Allah"" who gave me the opportunity to continue my higher studies and finish this research.

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## الإقرار

أنا الموقعة أدناه، مقدّمة الرسالة التي تحمل العنوان:

**Pesticide residues in imported sweet peppers, tomatoes and grapes in  
the north West Bank**

أقر بأن ما اشتملت عليه هذه الأطروحة إنما هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد. وأن هذه الرسالة كاملة، أو أي جزء منها لم يقدم من قبل لنيل أي درجة أو لقب علمي أو بحثي لدى أي مؤسسة تعليمية أو بحثية أخرى.

**Declaration**

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

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## List of Abbreviations

<b>GC-MS</b>	Gas chromatography- mass spectrometry
<b>MRL</b>	Maximum residue limits
<b>ADI</b>	Acceptable daily intake
<b>GAP</b>	good agricultural practices
<b>NGOs</b>	A non-governmental organization
<b>PCBs</b>	Palestinian Central Bureau of Statistics
<b>WHO</b>	World Health Organization
<b>FAO</b>	Food and Agricultural Organization
<b>FDA</b>	Food and Drug Administration
<b>ARs</b>	Anticoagulant rodenticides
<b>DDT</b>	Dichloro-Diphenyl-Trichloroethane
<b>EFSA</b>	European Food Safety Authority
<b>JMPR</b>	The Joint FAO/WHO Meeting on Pesticide Residues
<b>LC-MS</b>	liquid chromatography mass spectrometry
<b>INSO</b>	Iranian National Standard Organization INSO
<b>APO</b>	Asian Productivity Organization

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**Abstract**

Pesticide residue is dangerous contaminants that affect fruit quality and causes a hazard for human health. In this study total of 38 samples of pesticide residues were estimated for the imported fruits of grape, tomato, and sweet pepper crops in the North West Bank. Also, ten samples from local products were tested as a control. Samples were prepared for examination at the National Agricultural Research Center of the Ministry of Agriculture in Jenin NARC.

The pesticide residues were detected using a GC-MS device following the standard protocol in an-Najah National university labs. A questionnaire on products safety in the local market was also prepared and filled by 500 consumers from the same study sites. The results of the samples revealed no residues were detected in the tested samples, whereas for the local samples it was found two types of pesticide residues of Chlorpyrifos and Pencyazole in three samples.

The results of the questionnaire showed that about 85% of consumers do not feel safe when consuming fruits and vegetables bought from local markets, about 92% of consumers support the presence of vegetables and fruits in the market bearing a certificate showing they use of

good agricultural practices, and 80% of them agree to pay a higher price for such labelled-products. It was also found that women have more confidence than men in the farmer's commitment to good agricultural practices. Large age groups had more information about safe agricultural products and the presence of pesticide residues in fruits and vegetables.

The results showed that older age groups are more willing to pay a higher price for obtaining safe agricultural products. It was also noted that people with higher incomes were more willing to pay a higher price for safe agricultural products.

# Chapter One

## Introduction

### 1.1 Backgrounds

Pesticides are chemical substances applied to crops at various stages of cultivation and crops' storage. The use of pesticides is intended to prevent food crops' damage by controlling agricultural pests, diseases or unwanted weeds and improving plant quality (Bakırcı, et al. 2014).

Pesticides are classified according to their use into six main categories based on use insecticides, fungicides, herbicides, rodenticides, fumigants, and insect repellents (Hassaan and Nemer 2020).

The excessive and improper use of pesticides lead to contamination of the environment and food (due to pesticide residues) and caused many harmful effects on human health. Pesticides were associated with a wide range of hazards to human health, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, endocrine disruption, and reproductive harm (Chen, et al. 2011).

Serious problems are associated with the presence of pesticide residues in food', especially when fruits are consumed fresh, consisting of more than 30% of consumers' diet. It could be the primary source of residues in the human body (Szpyrka, et al. 2015).

To minimize these residues in food and protect the public health the regulatory authorities in many countries have established agricultural policies, maximum residue limits (MRL), acceptable daily intake (ADI), and started moving towards new agriculture methods such as organic farming and integrated pest management. Besides, many countries have made the good agricultural practices (GAP) certificate as a prerequisite for the products they import (ZENGİN and KARACA 2018). As defined by FAO, GAP are a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability (FAO 2003). GAP includes a different collection of codes, standards, and regulations established by governments, NGOs, and the private sector. Furthermore, these regulations are intended to enhance 'agriculture's sustainability in several ways, including protecting natural resources and improving food quality and health by improving conditions and protection for workers, creating new business opportunities for farmers and improving monitoring (Hobbs 2003). GLOBAL GAP (earlier known as EUREPGAP) has established itself in the worldwide market place as a critical reference for Good Agricultural Practices (GAPs) (Pandit, et al. 2017).

## **1.2 Objectives of the study**

This research aims to:

- Determine pesticide residues in imported sweet pepper, grape, and tomato using gas chromatographic (GC) and compared it with a local grape.
- Explore the consumers opinion on safe agricultural products in the local market

## **1.3 Agriculture in Palestine**

In 2015 the Ministry of Agriculture and Palestinian Central Bureau of Statistics (PCBs) estimated the total area of agricultural land in Palestine was 1,207,061 dunum (91.6% in the West Bank, and 8.4% in Gaza Strip). Various types of vegetables, crops and fruits are grown in Palestine.

Vegetables represent 65% of the agricultural sector's production like tomato, cucumber, eggplants, squash, paprika and green beans. Palestinians produce more than 87,210 tons of vegetables annually. The local production of fruit trees represents 16% of the total production like Citrus, Almonds, Dates, Guava, and Grapes (ARIJ 2015).

## **1.4 Productions of grapes, sweet pepper, and tomato in Palestine**

Grape growing are widespread around the world, and the cultivated area was estimated in 2014 at 7.6 million hectares (Grimalt & Dehouck,

2016). Grapes are consumed both as fresh and as processed products such as wine, jam, raisins, juice, jelly, vinegar and grape seed oil.

Grapes constitute about 12% of the total agricultural production in Palestine and it occupies the second position after olives in terms of the amount of production (ARIJ 2015). The land cultivated with grapes in Palestine is estimated at 38,679 dunum. This crop's annual production is estimated at 50,065 tons in the West Bank. Hebron governorate is the highest producer of grapes, constituting 58% of total production, followed by Bethlehem governorate (27%) and Jenin governorate (6%) (ARIJ 2015).

According to the Ministry of Agriculture the area planted with pepper was 1,512 dunums in the West Bank in 2013 and the annual production in is estimated at 9,487 tons. The area of pepper cultivated lands in Palestine is 4864 dunums, 1340 dunums are cultivated in plastic houses, cultivated widely in the areas of Tulkarm, Tubas and Jericho (Al Husain 2014).

According to the Ministry of Agriculture statistics, in 2013, the area cultivated with tomato was 11,999 dunums, and the total annual production reached up to 124,445 tons, representing 23% of the total production of all vegetable crops. Jenin Governorate is the largest producer of tomatoes it accounts for 35% of the total production, followed by Tubas Governorate (24%) and Hebron Governorate (12%) (ARIJ 2015).

## **1.5 Problem statement**

There is a problem in the use of agricultural pesticides in the Arab countries, Palestine is one of these countries, the problem is the misuse of pesticides and the disposal in addition to poor monitoring of the effects of these pesticide residues on water safety, food and public health which led many European countries to prevent importing agricultural products from some Arab countries (Al-Saed 2011).

Palestinians are trying to control the importing and use of pesticides and continuing inspections of licensed vendors, including store inspections selling agricultural pesticides. However, many pesticides are imported and marketed illegally due to the current political situation - particularly Israel's refusal to allow Palestinians to monitor borders (Aidy, et al. 2017).

The spread of traditional agriculture in Palestine and the intensive use of pesticides, especially in irrigated agriculture, in the absence of a law that compels farmers to adhere to the correct standards, in addition to importing fruits and vegetables without conducting tests to ensure the quality which exposes the Palestinians to many health risks resulting from these chemicals in addition to the competition with the local products.

Various types of fruits and vegetables are imported into the West Bank's central markets through. These products are increasingly competitive for similar Palestinian products, especially during the production seasons. Therefore it is necessary to monitor importing fruit and

vegetables especially in the harvest seasons and control their quality because large portion of them enter illegally and their quantities are not recorded in the statistics of the Palestinian Ministry of Agriculture.

The Palestinian Ministry of Agriculture indicates that 82% of vegetables in the local markets come from local production, whereas 71% of fruits are imported from or through Israel (ARIJ 2015). The most types of fruits and vegetables imported are onions, citrus fruits, potatoes, grapes, and tomatoes.

The Israeli farmers use many pesticides, Berman et al 2013 found the consumers is exposed to high levels of pesticides, higher than those in the US and Canada. Furthermore, the consumption of fruits was an essential source of exposure:-

As a result, a general trend has emerged that the future of agriculture lies in moving away from the use of agricultural chemicals such as fertilizers and pesticides and adopting a new approach that considers the preservation of the ecosystem.

In Palestine, there are some initiatives by several farmers and those interested in this field to apply sustainable agriculture, organic agriculture, and good agriculture practices. For example, in Gaza City, a group of farmers applied projects to implement good agriculture practices on vegetables and fruits. Marketing of their products was facilitated and they provided with the necessary support and guidance for the success of their initiatives.

## **Chapter Two**

### **Literature Review**

Fruits and vegetables are an essential component of every person's diet, as they provide the most important nutrients that the body needs and the most important vitamins. Attention is also paid to eating vegetables and fruits as a protective food that protects the body from many diseases such as cancer, heart disease, diabetes, and obesity (Keikotlhaile and Spanoghe 2011). The World Health Organization Food and Agricultural Organization (FAO/WHO) recommend a daily minimum of 400 g of fruits and vegetables to prevent chronic disease such as cancer, diabetes, obesity and heart disease (Nakano, et al. 2016).

The high incomes of individuals in developed countries led to consumer demand changes, especially for agricultural products. On the other hand, the spread of food-borne diseases in the late 1990s and the fear of depleting polluting agricultural resources causing the search for new methods that change traditional farming systems (Akkaya, et al. 2006).

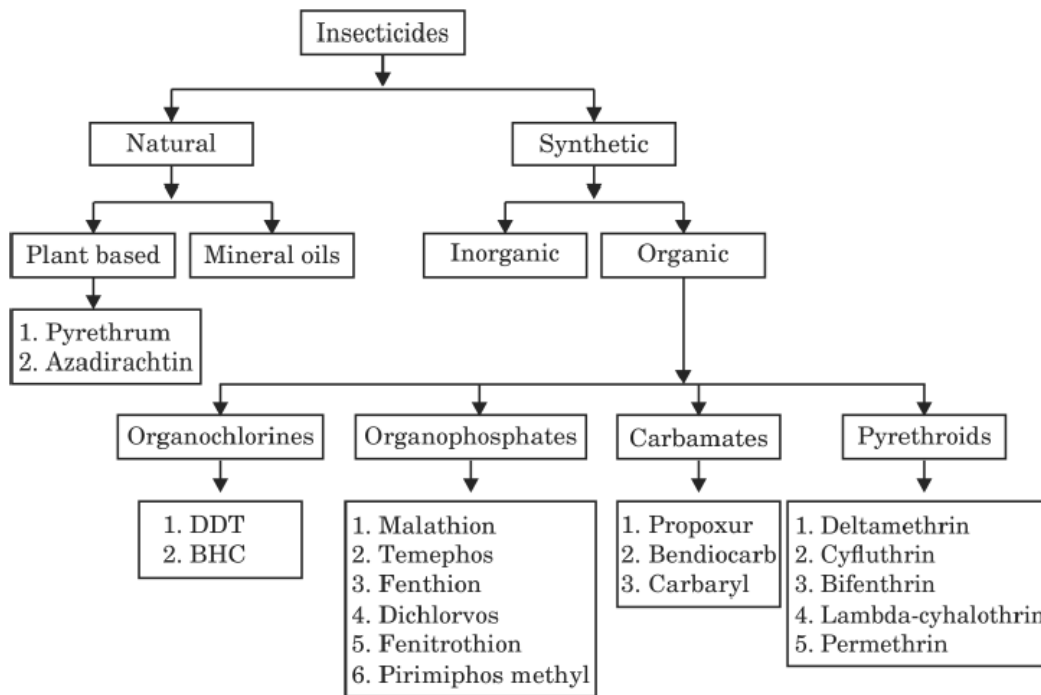
After 1970, new methods of agriculture were introduced to meet consumer demands and conserve natural resources. Among these is the use of organic farming that only uses organic matter in the farming process, and sustainable agriculture that increases productivity in agriculture and economic prosperity by protecting all living things on earth and natural resource (Muneret, et al. 2018).

In 1997, good agricultural practices (GAPs) emerged as a new method of agricultural production by the U.S. Food and Drug Administration (FDA), intending to reduce the risks associated with consuming fruit and vegetables (De, et al. 2019).

## **2.1 Pesticides**

Vegetables and fruits are exposed to many pests that affect their production that differ in their sources, types, and period of Impact on the crop. Therefore, farmers worldwide used agricultural pesticides to protect their crops and increase production. The use of pesticides during production often leads to the presence of pesticide residues in fruits and vegetables after harvest. Pesticides can be classified:

1. Insecticides: Insecticides are important pesticides that can be further classified into several sub-classes, as given in figure 2.1 (Kaur, 2019). There are four main groups of insecticides based on chemical functions; Organophosphate OPS, Carbamate, Pyrethroids, and Organochlorins (Fothergill & Abdelghani, 2013). Organochlorine is an insecticide used to control many diseases such as malaria and typhus, but its use was banned or restricted in most developed countries in the 1960s (Aktar, et al. 2009).



**Figure 2.1:** classification of insecticide (Kaur, et al. 2019).

2. **Herbicides:** Herbicides is one of the types used to damage unwanted plants, and they constitute approximately 60% of the world's pesticides (Dayan, 2019). Modern herbicides were classified in different ways, one of them according to the chemical category such as Triazine, Chlorophenoxy, Organophosphorus, Pyridine, Thiocarbamates, Amides, Bipyrilium compounds (Manno, et al. 1996).

3. **Rodenticides** are pesticides that kill rodents, including mice and rats, squirrels, woodchucks, moles, and other small animals. It is usually used by adding it to the food, and it is classified into organic compounds like Sodium Fluoroacetate, Anticoagulants, Strychnine, and inorganic compounds like Arsenic, Thallium, Phosphorus, Zinc phosphine (Blair, et al. 2014).

Anticoagulant rodenticides (ARs) are the most used type of rodenticides. Still, it has side effects represented in its impact on non-target organisms such as bird prey (Nakayama, et al. 2019).

4. Fungicide: Pesticides are used to prevent the growth or killing of fungi and their spores. The classification of fungicides based on chemical nature like; Benzimidazoles, Conazoles, Morpholines, Amides, Anilinopyrimidines, Dithiocarbamate, Organochlorine and Phthalimide (Gupta, 2011). Fungicides may have side effects that affect other non-target terrestrial organisms (Yang, et al. 2011).

The use of pesticides raises many environmental concerns because of the adverse effects on humans and the environment. Over 98% of the sprayed pesticides and 95% of the herbicides reach the air, water, and soil (Harb, 2016). The World Health Organization found that every year there are about 3,000,000 pesticide poisoning cases and that there are almost 220,000 deaths due to toxic residues and improper use in the developing countries (Kaur, et al. 2019).

## **2.2 Pesticides used in Palestine**

In 2010 the Central Statistical Bureau of the Palestinian Authority identified pesticide use in the West Bank and Gaza as an "excessive" risk of reduced soil fertility and water pollution (Watts et al. 2016).

In the West Bank, the average annual use of agricultural fertilizers is 30,000 Tons of fertilizers and manure. The average annual use of pesticides was 502.7 tons. Part of these pesticides are unknown and unauthorized entering illegally through Israel (Issa et al. 2017). Some of these pesticides are banned by the World Health Organization, including DDT, Aldicarb, Lindane, Chlordan, Paraquate, Parathion, and Pentachlorophenol (Saleh et al. 1995). The most types commonly used are insecticides and fungicides (PCBS 2010).

The use of chemicals in Palestine involved different sectors and fields, especially in the irrigated agriculture, which affects the fertility of the soil and pollutes the water and their effect on human health.

A study conducted from 2012 to 2015 to determine the types of pesticides used in Palestine reported that 12 chemical groups of pesticides, the most used of which was Phosphonoglycine (Issa et al, 2017).

### **2.3 Pesticide residues**

Pesticide residue refers to the pesticides that may remain in or on crops after using pesticides. To minimize these residues in food and protect the population's health, the regulatory authorities in many countries have established agricultural policies, maximum residue limits (MRL) and acceptable daily intake (ADI).

The maximum residual level is the highest level of residue in products expected to be in the food after using pesticides. It is always set below levels believed to be safe for humans.

### **2.3.1 Pesticide residues determination**

To minimize exposure to pesticide residues in food and protect, the regulatory authorities in many countries have established systems for monitoring agricultural products and their environmental impact. Chromatography is a powerful separation technique suitable for the quantitative analysis of compounds with very similar chemical structure (Cserhádi and Szőgyi 2012). Various techniques used such as:

1. GC-MS: The instrument Gas Chromatography/Mass Spectrometry (GC/MS) separates chemical mixtures (the GC component) and identifies the components at a molecular level (the MS component). It is one of the most accurate tools for analyzing environmental samples. The GC works on the principle that a mixture will separate into individual substances when heated. The heated gases are carried through a column with an inert gas (such as Helium). As the separated substances emerge from the column opening, they flow into the MS. Mass spectrometry identifies compounds by the mass of the analyte molecule. The determination of GC-MS with a QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) Method has emerged in the last decade as a valuable approach, which allows higher selectivity and sensitivity and minimizes or even removes most chromatographic interferences (Hernández, et al. 2013). The C/MS

technique used to separate volatile organic compounds, pesticides and has been used in studies of pesticide residues in fruits and vegetables (Chen et al. 2011).

2. LC-MS: "liquid chromatography mass-spectrometry". this technique is quickly gaining acceptance for pesticide residue testing. LC/MS/MS can be used to simultaneously monitor hundreds of potential contaminants—including those difficult to detect by GC. The high selectivity provided by LC-MS/MS allows for the determination of many pesticides belonging to different chemical families in one run (Stachniuk et al. 2017).

3. High-performance liquid chromatography HPLC :is a cheap and effective method for different pesticide types. HPLC is amenable to a wide range of applications, such as pharmaceuticals and food analysis. It is beneficial for low or non-volatile organic compounds, which cannot be handled with gas chromatography (Munawar and Hameed 2013).

### **2.3.2 Pesticides residues in fruits and vegetables around the world**

Many countries have examined pesticide residues in many fruits and vegetables and compared them to the maximum residues limits (MRL). In Saudi Arabia 160 samples of vegetables are collected from 4 markets, residues were found in 89 samples and 54 samples were found above the maximum residue levels (Osman, 2011).

Another study was to investigate pesticide residues in fruits and vegetables from the Aegean region in Turkey. A total of 1423 samples of fresh fruit and vegetables were collected from 2010 to 2012. The samples were analyzed to determine residues from 186 types of pesticides. The results were evaluated according to maximum residue limits (MRLs). A total of 754 samples contained residues at or below MRL, (8.4%) of the fruit samples and (9.8%) of the vegetable samples contained pesticide residues above MRLs. MRL values were most often exceeded in lemon, Arugula, Cucumber and Grape. All detected pesticides in apricot, carrot, kiwifruit and leek were below MRLs, the most detected pesticide residues Acetamiprid, Chlorpyrifos and Carbendazim (Bakırcı, et al. 2014).

In Slovenia (47) samples of grapes were analyzed for the presence of 67 pesticides, one grape sample contained no residues, 28 samples contained residues lower or equal than MRLs and 18 samples exceeded national MRLs for Cyprodinil and Fludioxonil (Česnik, et al. 2008).

In Turkey, 2018, green peppers and cucumbers were analyzed for 170 pesticides. Pesticide residues were detected in 12.9% of pepper samples and 13.5% of cucumbers with levels were below the MRLs, all kinds of pesticide residues found in green peppers includes Thiamethoxam, Spinosad, Acetamiprid, Tebuconazole, Metalxyl, Cyprodinil, Triadimenol and Boscalid (Golge, et al, 2018).

In Iran pesticides residue was measured by applying GC/MS method six residues were found in 20.7% samples the pesticide residues was Chlorpyrifos 3.3%, Iprodione 6.0%, Permethrine 4.7%, Esfenvalerate 4.7%, Diazinon 2.0%, and Penconazole 1.3%. Only Iprodione, Chlorpyrifos, Permethrine, and Diazinon are registered for Iran's tomato production. With the exception of Chlorpyrifos and Diazinon the concentrations of Iprodione and Permethrine were found below the MRLs established by the Iranian National Standard Organization (INSO), Esfenvalerate and Penconazole are not registered for tomato production in Iran (Salamzadeh et al. 2018).

The Israel Union for Environmental Defense has found high levels of 105 different pesticides in fruits and vegetables, a third of which are banned in Europe. According to the organization's survey, grapes, celery and apples are the most contaminated by pesticides in Israel, which lists the 15 most contaminated. Grapes lead the list of contaminated fruits and vegetables followed by celery and apples. In fourth place is a citrus fruit classified as contaminated due to its peels - even though the peel prevents some pesticides from penetrating (Rinat 2012).

### **2.3.3 Pesticide residues in agricultural products in Palestine**

In Palestine minimal number of studies were conducted about pesticides. One of the important studies was conducted in 2018, including three cities in Jenin, Jericho, and Hebron. The results of the study indicated the excessive use of pesticides and the presence of more than one chemical

substance in one sample, and some samples reached four pesticides residue Fungicides and insecticides, the most important chemicals that were monitored in tomato and cucumber were 11 compounds: Triadimenol, Difenoconazol, Bromopropylate, Malathion, Penconazole, Thiocyclam Hydrogen, Chlorpyrifos, Flutriafor, Cypermethrin and Cyprodinil. Besides absence of a group of samples from toxic residues for some farms that use integrated pesticide management (Hosani and Atawneh 2018).

Another study was conducted in Wadi Fukin area in Bethlehem. The data indicate that all farmers use agricultural chemical pesticides to control agricultural pests, 28% of farmers know the average amount of pesticides to be used, 83% of farmers follow instructions in using pesticides and 90% of farmers use more than one pesticide at the same time. The majority of farmers do not use protective clothing to protect against pesticides while dealing with pesticides. Also, it found that the majority of farmers suffer from the problem with weeds. The number of pesticides used reached more than 15 types and the most used pesticides are the herbicide Ductalon, Sift Super and Metribuzin known commercially as Sencor 70 (Hamdan.A, et al. 2018). In Palestine there are no published studies about pesticide residue in grape crops.

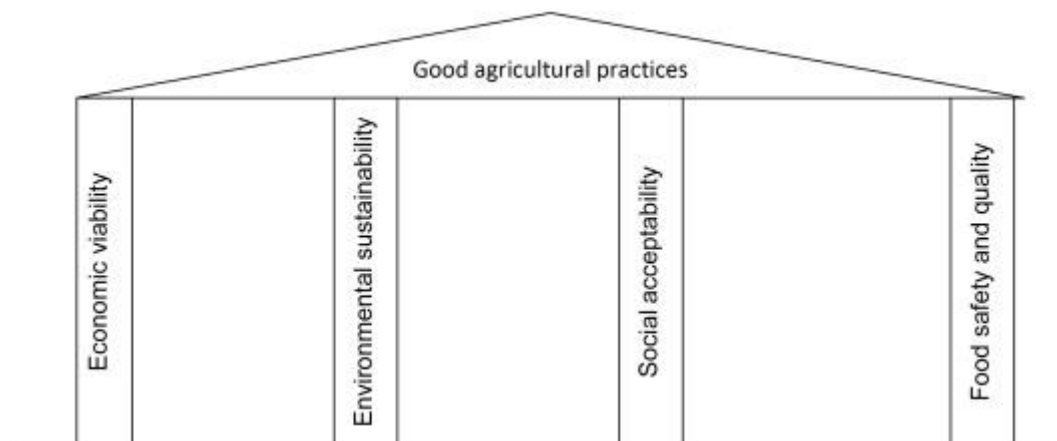
## **2.4 Good Agriculture Practice GAP**

The principle of good agricultural practices started to spread since the beginning of the twenty-first century due to the large increase in the population and increase their food and economic needs in addition to the

interest of many stakeholders in producing safe food with high quality while preserving health and the environment (Friedrich et al. 2012). Therefore, attention was paid to good agricultural practices to achieve the highest level of safe production, from preparing the farm to the end of the production process (APO 2016).

According to FAO GAP is a "collection of principles to apply for on-farm production and postproduction processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability" (Agnes, et al.2013).

Good agricultural practices rely on four pillars that are complementary to one another food safety, environment, workers health and products quality as in the figure 2.2 (Wongprawmas 2014).



**Figure 2.2:** Four Pillars of GAP (Gupta, et al. 2017).

### **2.4.1 Principles of good agricultural practices**

The FAO GAP guidelines address categories of farm resource concerns and activities various aspects that need to be managed.

1. Water : GAP managing water sources used in agriculture to ensure clean irrigation water free from harmful pollutants such as chemicals or mixing with wastewater. It also prevents the use of untreated wastewater during production. If treated wastewater is allowed, the water quality must comply with the applicable specifications (Akkaya et al. 2006).
2. Soil: analyze the type of soil and its depth for good growth of the roots, Consider the slope of the field, tilling and avoid soil erosion (Poisot 2004).
3. Crop and fodder production: The crops suitable for the site are chosen to meet the needs of the market and consumers, and good agricultural practices are based on consideration planting time, productivity, quality, market acceptability, nutritional value, and resistance Diseases, stress, curative, climate adaptation and response to fertilizers and agricultural chemicals. In addition, GAPs included the use of organic and inorganic fertilizers in an appropriate manner and quantities to compensate for the lack of elements in the soil and adherence to safety standards when using equipment, machinery, and feed. It seeks to maintain crop health by using strategies such as integrated pest management that include the

use of crops that are resistant to diseases and pests and the use of chemicals wisely to resist agricultural pests and disease (FAO 2003).

4. Animal production, health, and welfare :It includes providing adequate space for livestock, and is concerned with providing appropriate feed, clean water sources, and protecting them from pollution, as well as avoiding negative impacts on landscapes and the environment. In addition, design, construction, selection, use, and maintenance of equipment to avoid injury and loss and safely dispose of veterinary medicine and chemical waste (FAO 2003).
5. Harvest and on-farm processing and storage: The quality of the product depending on the harvesting and storage process; therefore GAPs seeks to make the process organized and within laws and regulations such as keeping the product at appropriate temperatures, humidity, storage areas, the animal slaughter process and packing the products in clean transport containers (APO 2016).
6. Energy and waste management: Energy-related good practices Waste management include developed input and output plans for agricultural energy, Nutrients, and agrochemicals to ensure their practical use and safe disposal. It also includes organizing the use of fertilizers and storing chemical materials safely and within legislation and laws (FAO 2003).

7. Human welfare, health, and safety :One of the most important components of the GAP is human health and safety. Agriculture must be economically feasible for people to continue and be sustainable and practices related to human health and must be achieved in a balanced manner with environmental, social and economic elements to provide appropriate income and maintaining food security (FAO, 2003).
8. Wildlife and land scale: Good practices include preserving wildlife, diversity, landscapes and protecting it from various processes during the cultivation process, such as tillage and use of agricultural chemicals (Akkaya, et al. 2006).

#### **2.4.2 GAP in the world**

Recently, many importing countries have moved to implement GPA as a prerequisite to ensure their products' quality and safety. It has been found that its application guarantees the best use of resources such as water, pesticides, fertilizers, and soil and protecting the social aspect that includes workers from the inappropriate use of chemicals, and thus obtaining safe products for the consumer, the product and the environment (FAO 2016).

##### **2.4.2.1 GLOBAL GAP**

The Food and Agriculture Organization of the United Nations (FAO) GAP approach is not the only set of international standards for good agricultural practices. In the late 1990s, Euro-Retailer Produce Working

Group and Good Agricultural Practices (EUREPGAP), a common standard for farm management practice.

GLOBAL GAP is a private sector body that sets global standards for ensuring good agricultural practices for quality assurance based on risk management and attention to food safety, occupational health, and the environment (Raymond, 2014).

GLOBAL GAP was created by a group of large European store owners in cooperation with suppliers to achieve the various standards for suppliers that often caused problems with farmers. In September 2007, EUREP GAP changed its name to GLOBALGAP to reflect its expanding international role in establishing GAP for multiple retailers and their suppliers (FAO 2016)

In 2001 EUROPE GAP obtained the first ISO 65 certification of fruits and vegetables. It started to award the first farm certificates the standard spread throughout Europe and beyond in the following years (Masood and Brümmer 2014).

As of February 2011, over 100,000 producers in more than 100 countries were GLOBALGAP certified (Carter 2011).

GLOBAL GAP carries out annual inspections of producers, in addition to unannounced methods of inspection through a set of documents including general regulations, compliance standards, GLOBAL GAP monitoring points, and the global gap checklist.

In Europe, most buyers of fruits and vegetables adopt GLOBAL GAP certification, including Tesco, Carrefour, Aldi, Asda, and Metro group. Globally, retailers from South Africa, Japan, and the United States have joined, including Wal-Mart and McDonald's, relevant organizations in some countries such as China, Japan, and Kenya have compared pre-existing quality standards with global products and noticed that purchases by non-certified producers decreased (Tennent and Lockie 2012).

#### **2.4.2.2 ASEAN GAP**

A group of Southeast Asian countries established the ASEAN GAP system for fruits and vegetables in 2006 within GAP standards to control risks during production and after harvesting fruits and vegetables in Asia. Moreover some, countries in Asia have developed their capabilities and have government certification systems such as Malaysia, Philippines, Indonesia, and Thailand (Valk and Roest 2009).

ASEAN GAP includes four compliance standards: Food Safety, Environmental Management, worker health, safety and welfare, and the quality of production. Every country that develops the GAP system must adhere to these four units (APO 2016).

#### **2.4.2.3 Arab GAP**

With the spread of the theory of good agricultural practices worldwide, the Arab Organization for Agriculture and Development (AOAD) created the Arab Gap Guide in 2007 based on the GLOBAL GAP

standard and focused on producing fruits and vegetables. AOAD Arab GAP Directory provides general rules, certification process, support bodies, and the oversight mechanism (ESCWA,2018).

In 2017, the Saudi Ministry of Environment, Water and Agriculture developed a plan to develop a Saudi plan to create a special unit for good agricultural practices SGAP that is interested in registering the producers who want to obtain a certificate of goodwill in agricultural practices (Saudi Arabia GAP) and set up a program to guide and evaluate producers and give them a certificate for a year that can be renewed later (ESCWA 2018).

#### **2.4.2.4 GAP in Palestine.**

Like the rest of the world, Palestine has started to search for ways to produce healthy foods and reduce the impact of pesticides and chemicals used in agriculture.

In 2016, a Palestinian study was conducted on 39 farms, three of them adopting organic agriculture. The results indicated that Palestinian farmers are dependent heavily on chemicals to increase profit, increase profit. Heavy use of chemicals inefficiently, primarily affecting the consumer negatively. The study also showed the ability of a group of farmers to use organic agriculture. Still, they need support and organize the process of marketing their products on the local and external markets (Harb et al. 2016).

In 2018, a guide for good agricultural practices was prepared to preserve the soil content of organic matter and moisture in Palestine in cooperation with the Ministry of Agriculture and the Environmental Quality Authority to highlight good agricultural practices to conserve the soil as the main medium for the cultivation process through managing resource use, reduce its degradation and increasing Product quality (MEnA 2018).

In the same year, two guides were prepared in the Gaza Strip by Al-Azhar University, the first on safe agricultural production for vegetable farms. The second was on safe agricultural production for milk farms.

In 2019, a national good agricultural practices training manual for fresh vegetable and fruit crops was prepared with the aim of raising the level of safety of agricultural products from vegetables and fruits and reducing the risk of pollution by adopting sound procedures that take into account health and safety conditions during the process of planting, harvesting, transport, and storage (ESCWA 2019).

## Chapter Three

### Methodology

#### 3.1 Study site (Palestine –West Bank)

The area of Palestine is 27 thousand km<sup>2</sup>. The West Bank area is (5655) km<sup>2</sup> divided into 11 governorates as shown in figure 1, and the Gaza Strip is (365) km<sup>2</sup>, divided into 5 governorates.



Figure 3.1: Map of the West Bank.

According to population estimates prepared by the Palestinian Central Bureau of Statistics in 2020, about 13.5 million Palestinians in the world are about 5.1 million in the State of Palestine. The West Bank's estimated population was about 3.05 million, while the population of the Gaza Strip for the same year was estimated at 2.05 million (PCBS 2020).

The agricultural land covers more than 120,000 ha that is cultivated with all kinds of vegetables and field crops and the groves of fruit trees. According to the definitions of the Palestinian Ministry of Agriculture, Palestine is divided into five agricultural and environmental zones:

- The coastal plain zone (Gaza Strip) extends from the North to South on the Mediterranean Sea's south-eastern shores.
- The semi-coastal zone –the north-western corner of the West Bank, includes the governorates of Jenin, Tulkarem, and Qalqilia .
- The middle elevation zone ranges from Jenin in the North to Hebron in the South.
- The steppe zone extends from Eastern Jenin to the Dead Sea in the South.
- The fifth zone is located in the Western Jordan Valley.

In this study, the northern West Bank was selected, including governorates Jenin, Tubas, Tulkarm, Nablus, Qalqilya, and Salfit. According to the Palestinian Central Bureau of Statistics in 2017, the population of the specified governorates is shown in table 3.1.

**Table 3.1: Governorates population included in the questionnaire.**

Governorate	Population
Jenin	310,000
Tubas	60,000
Tulkarm	190,000
Nablus	380,000
Qalqilya	110,000
Salfit	75,000
Total	1,125,000

## 3.2 Social survey

### 3.2.1 Study Sample

Five hundred persons were chosen to fill the questionnaire in the northern West Bank (Jenin, Tubas, Tulkarm, Nablus, Qalqilya, and Salfit) in August of 2020. According to the Palestinian Statistics Center, the average family size is five persons, so the number of families that make up the study community is approximately 200,000 families. Based on the statistical tables' data, the sample size when the study population is greater than 100,000 at confidence level 95% must be greater than 384 samples as shown in table 3.2.

**Table 3.2: statistical tables used to determine population sample (Dawood 2019).**

	Confidence level 95%			Confidence level 99%		
	Margin of error			Margin of error		
Population size	5%	2.5%	1%	5%	2.5%	1%
100	80	94	99	87	96	99
500	217	377	475	285	421	485
1,000	278	606	906	399	727	943
10,000	370	1,332	4,899	622	2,098	6,239
100,000	383	1,513	8,762	659	2,585	14,227
500,000	384	1,532	9,423	663	2,640	16,055
1,000,000	384	1,534	9,512	663	2,647	16,317

### 3.2.2 questionnaire content

The questionnaire was divided into three main parts:

- The first includes general information such as gender, age, governorate, place of residence, average income and average monthly consumption of vegetables and fruits.
- The second part focuses on consumers' prior knowledge of safe agricultural products, pesticide residues in fruits and vegetables, their dealings with these products in the market, and their confidence in them.
- The third part focuses on the extent of acceptance of safe agricultural products in the market, the presence of certificates that distinguish them from others, and their acceptance of the increase in the price of safe agricultural products compared to traditional products.

### 3.2.3 Research Hypothesis

The research hypothesis (null hypothesis):

- First hypothesis: there is no significant difference between the gender and the confidence in farmers' products at P-value  $\leq 0.05$ .
- Second hypothesis: there is no significant difference between age and the confidence in the farmers' commitment to using correct pesticide use standards at P-value  $\leq 0.05$ .
- Third hypothesis: there is no significant difference between average monthly income with the consumers willing to pay a higher price for safe agricultural products at P-value  $\leq 0.05$ .
- Fourth hypothesis: there is no significant difference between age with the consumers willing to pay a higher price for safe agricultural products at P-value  $\leq 0.05$ .
- Fifth hypothesis: there is no significant difference between age with confidence in agriculture products free of pesticide residues in the Palestinian markets at P-value  $\leq 0.05$ .

### 3.3 Laboratory work

Grapes, cherry tomato and sweet pepper samples were identified, collected and prepared by QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe).

Method for examination at the Agricultural Research Center of the Ministry of Agriculture in Jenin was used and then samples sent to the toxicology laboratory at An-Najah National University for testing using GC/MS Chromatography.

### 3.3.1 Sample collection:

Grapes, cherry tomato and sweet pepper samples were obtained from fruit and vegetable shops known to sell imported fruits and vegetables, and there is a trademark on them indicating the place of import as in figures 3.2, 3.3, and 3.4 to make sure that they are imported products and not from West Bank farms.



**Figure 3.2:** Imported grapes in Palestinian markets.



**Figure 3.3:** Imported tomato in Palestinian markets



**Figure 3.4:** Imported sweet pepper in Palestinian markets.

### **3.3.2 Samples distribution**

The imported samples were collected at different periods, including March, July, and September of the year 2019. In addition to ten grape samples from the local production, they were randomly collected in July 2020 from the West Bank markets. The distribution of the samples chosen is shown in table 3.3.

**Table 3.3: Distribution of the study samples.**

Place	Grapes samples	Sweet pepper samples	Tomato samples
Jenin	3	3	2
Tulkarm	3	3	2
Ramallah	3	3	2
Nablus	3	3	2
Qalqelia	3	3	-
Local production	10	-	-
Total	25	15	8

**3.3.3 Equipment and materials used for fruit sample analysis:**

The following equipment and materials were used in the analysis:

a) Gas chromatograph/mass spectrometer- single quadruple, GC/MS with electron impact (EI) ionization, an autosampler (AS) and computerized instrument control/data collection from Perkin Elmer Clarus 500. Characteristics of the GC used as illustrated in the table 3.4 and the characteristics of the MS used as in table 3.5.

**Table 3.4: GC parameters**

GC Parameters	
Injector	250°C isothermal 1-mm i.d.splitless glass liner 1.0µL volume Split less time 1.0 min
GC Oven	100°C for 1 min 25°C/min to 150°C 10°C/min to 280°C for 10 min

**Table 3.5: MS parameters.**

MS Parameters	
Temperatures	Transfer line:250°C Source: 200°C
Full-Scan Mode	m/z 50-to m/z 650 Scan time: 0.20 sec Inter-scan Delay: 0.01 sec
SIR Mode:	3 ions per SIR Function 0.04 sec dwell 0.01 sec delay

- b) Centrifuge from Benchmark Scientific for the 50 mL centrifuge tubes used for extraction.
- c) Balance (accurately measuring weight from 0.05 to 100 g within  $\pm$  0.01 g).
- d) Nitrogen Evaporator N-Evap from Gowegroup (B00HQUBXPI).
- e) Freezer for -20°C sample storage.
- f) Food chopper (Robotcoupe) and probe blender.
- g) Solvent evaporator for the evaporation of Acetonitrile extracts.
- h) Pipette (10 $\mu$ L to 100 $\mu$ L tip capacity).
- i) Autosampler vials and caps.

### 3.3.4 Reagents

Acetonitrile (residues grade) with purity  $\geq$  99.8% and Acetic Acid glacial from (Merck KGaA, Darmstadt, Germany), Sodium Acetate

anhydrous granular 99.0% purity and Magnesium sulphate anhydrous powder 99% purity from (J.T.Baker, Ecatepec de Morelos, Mexico), Primary Secondary Amine solid phase packing (PSA) from Agilent Technologies (Santa Clara, USA), Triphenyl Phosphate TPP (Sigma Aldrich, Supelco, Bellefonte, Pennsylvania, USA), Helium (purity that has been demonstrated to be free of interfering compound in GC-MS), Toluene (AR,  $\geq 99.5\%$ ) by Macklin Reagent (Shanghai, China).

#### **3.3.4.1 Preparation of reagent:**

- 50 ml centrifuge tube containing  $6.0 \pm 0.3$  g anhydrous Magnesium sulphate +  $1.5 \pm 0.1$  g anhydrous Sodium Acetate per 15 g sample.
- 10-15ml centrifuge tubes containing  $0.40 \pm 0.08$  g PSA sorbent +  $1.20 \pm 0.24$  g anhydrous Magnesium sulphate extract taken for cleanup.
- Triphenylphosphate TPP solution= 40 ppm TPP in 1% Acetic acid.

#### **3.3.5 Samples preparation**

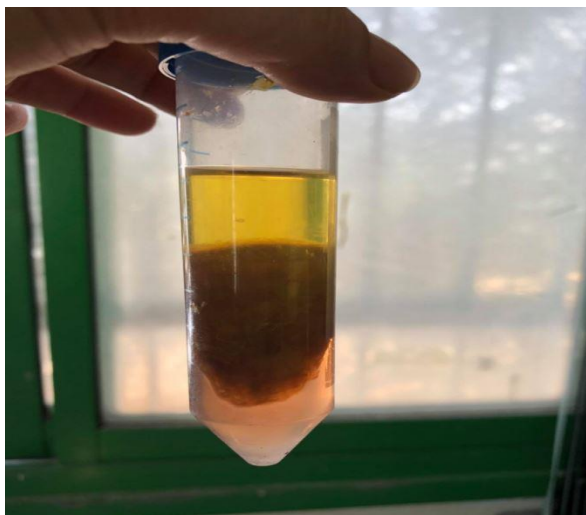
The preparation process was performed using the following steps:

1. Samples were cut using a knife and then blended using a laboratory blender with a variable speed.
2. Samples stored in the freezer ( $< -20^{\circ}\text{C}$ ) for processing.
3. After taking the samples out of the freezer, samples were blending with a mixer until it is homogeneous, and then 15 g was taken.

### 3.3.6 Samples extraction

The extraction process was performed using the following steps:

1. 15 ml of 1% Acetic acid in Acetonitrile with 75  $\mu$ L 40 ppm of TPP was added to 15 g of sample in centrifuge tube 50 ml.
2. 6 g Magnesium sulfate and 2 g Sodium acetate was added per 15 g sample and then centrifuged at 3500 rpm for 5 min.



**Figure 3.5:** Samples after centrifuging at 3500 rpm for 10 min

3. 8 ml of Acetonitrile extracts (upper layer) were transferred to a new tube with 0.5g PSA and 1.2g MgSo<sub>4</sub>.
4. The new tube was mixed by hand for 30 s and then centrifuged at 3500 rpm for 3 min.
5. 4 ml of Acetonitrile extracts was transferred to 15 ml centrifuge tube and then evaporated in N-Evap at 50°C and sufficient N<sub>2</sub> flow until volume reached 0.5 ml.

6. Toluene was added to take the extract up to 1ml, 1 ml of TPP, and MgSO<sub>4</sub> to reach 0.2ml on the tube.
7. The tube centrifuge for 1 min at 3500 rpm and 0.6 ml was transferred of the final extracts to GC/MS.
8. Cap the vials and conduct GC/MS.

## Chapter Four

### Results and Discussion

#### 4.1 Chemical analysis results

##### 4.1.1 Imported vegetable samples

The results of analyzed imported samples of grape, cherry tomato and sweet pepper were explained in table 4.1.

**Table 4.1: The analyzed samples of imported grapes, tomato, and sweet pepper**

Imported samples	Analysis results
Grape	No pesticide residue detected
Cherry tomato	No pesticide residue detected
Sweet pepper	No pesticide residue detected

Table 4.1 showed that there is no pesticide residue in all imported samples. The absence of residues could be attributed to the adherence to the correct pesticide application, organic farming, good agriculture practice, integrated pesticide management, and regular monitoring of farms.

These results are similar to a study in Turkey examined 99 grape samples and did not find residues in samples taken from farms that adopt organic agriculture, and integrated pesticide management was only detected in samples taken from farms that adopt conventional agriculture (Turgut, et al.2011).

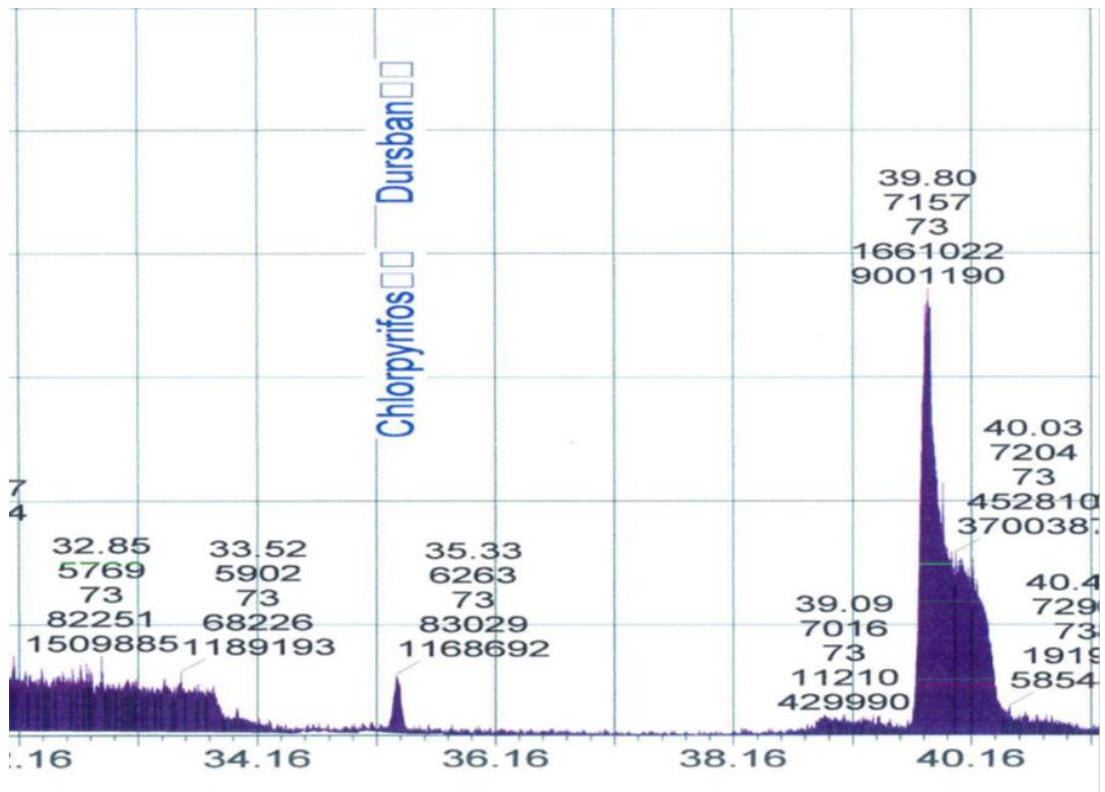
Another study was conducted in Brazil for 33 samples of tomato, and no pesticide residues were detected in the analyzed samples. As explained by the author, it was attributed to the commitment of tomato producers to the actual legislation and the adoption of good agricultural practices in the study area (Andrade et al.2011).

#### **4.1.2 Local grape samples**

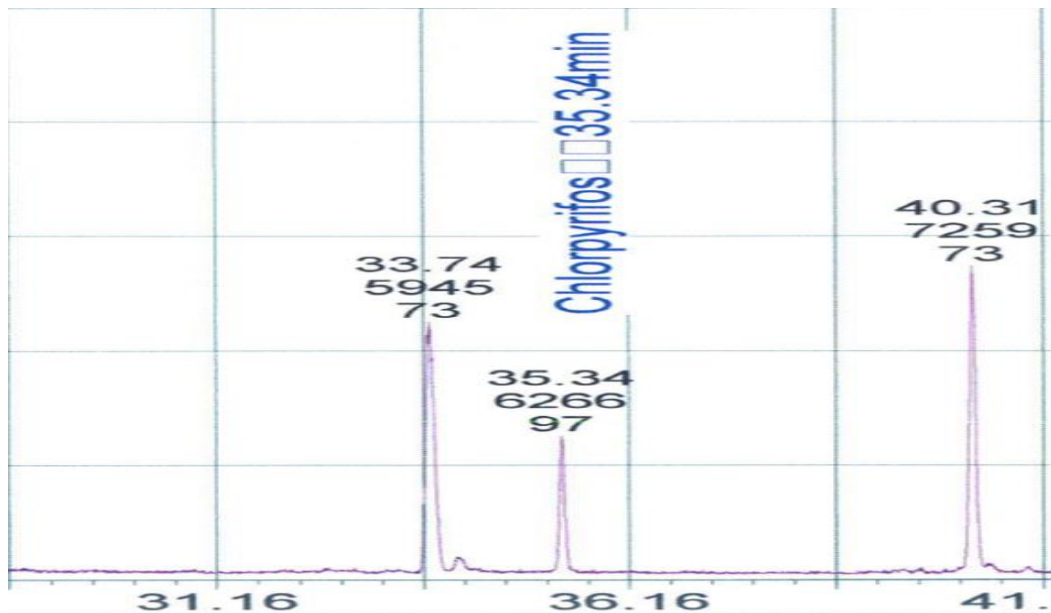
The analyzed ten random grape samples from local production in the West Bank markets were shown in table 4.2. Two types of residues were detected in three samples that were determined from the GC analysis result as in figures 4.1, 4.2 and 4.3.

**Table 4.2: Results of local grape samples.**

Number of samples	Results	Types of residue
1	One pesticide residue detected	Chlorpyrifos
2	No pesticide residue detected	-
3	One pesticide residue detected	Chlorpyrifos
4	One pesticide residue detected	Penconazole
5	No pesticide residue detected	-
6	No pesticide residue detected	-
7	No pesticide residue detected	-
8	No pesticide residue detected	-
9	No pesticide residue detected	-
10	No pesticide residue detected	-



**Figure 4.1:** Typical GC/MS chromatogram of local grape cortex sample (1) analyzed following the recommended procedures.



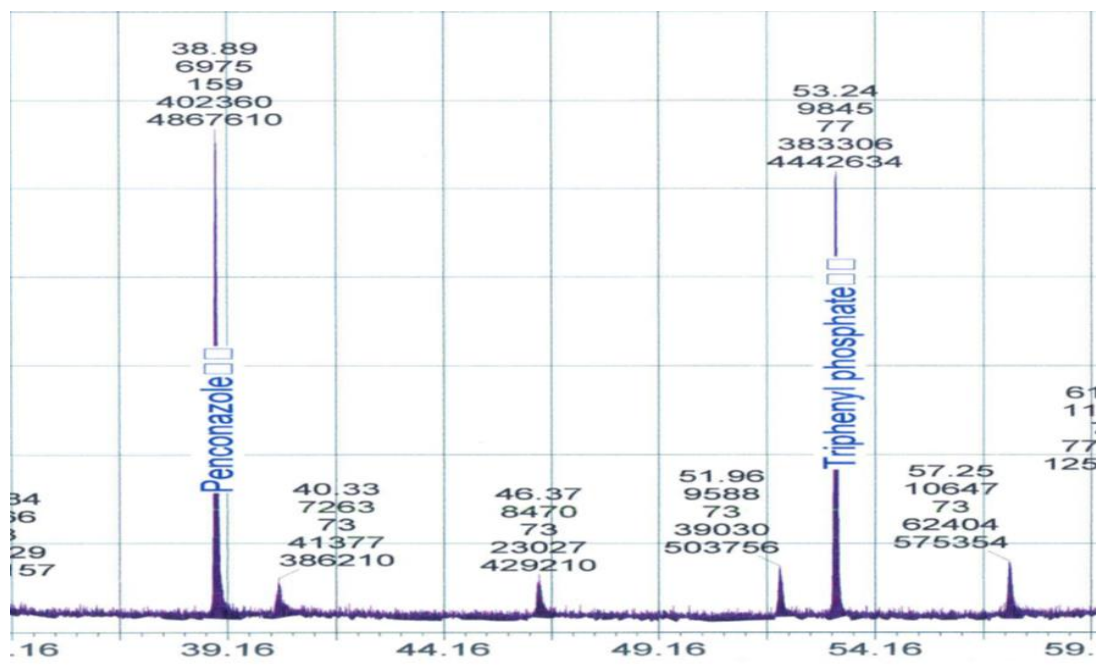
**Figure 4.2:** Typical GC/MS chromatogram of local grape cortex sample (3) analyzed following the recommended procedures.

Chlorpyrifos residues 'that's found in grape samples number one, and three as in figures 4.1 and 4.2 is an organophosphate insecticide that is registered in more than 98 countries to control pests infected more than 50 crops, licensed by the Ministry of Agriculture in Palestine. It comes under various trade names such as Dursban, Iordsban, Cobalt, Nufos, Warhawk, and Hatchet (Fang et al.2018).

The current finding is comparable with the results by Bouagga et al. (2019) were found residues in 94% of the examined grape samples, including Chlorpyrifos, which exceeded MRLs limits and indicated that these residues could pose a risk to the consumer's health (Bouagga, et al. 2019).

In addition Farshidi, et al.2020 were found Chlorpyrifos residues in tomatoes, oranges, and lettuce in quantities exceeding MRLs limits, and it was indicated that these results constitute a warning to consumers concerned about pesticide residues in food (Farshidi et al. 2020).

Penconazole residue 'that's found in grape sample number four as in figure 4.3 is a fungicide used to control powdery mildew in grapes. It has many scientific names like Traiazole, Award, Topas 100 and Topaze. It is licensed for use in grapes, and it is known in the West Bank under the commercial name Ofir. Among its health risks are potential endocrine problems in the liver - a weak estrogenic effect (Heshmati et al. 2020).



**Figure 4.3:** Typical GC/MS chromatogram of local grape cortex sample (4) analyzed following the recommended procedures.

The current finding is comparable with the results by Angioni and Dedola 2012 which showed that Penconazole residues are among the most common types of residues resulting from fungicides on grape crops (Angioni and Dedola 2012).

In Palestine, similar studies were conducted on different types of fruits and vegetables. Among them is Hosani and Atawneh 2018 which evaluated pesticide residues in 54 samples of tomato and cucumber. The results indicated the presence of fungicides and insecticide residues in the samples includes Penconazole and Chlorpyrifos residues (Hosani, 2018).

Furthermore, Samaneh 2004 evaluated residues in grape samples from local production in Palestine, the results obtained Penconazole and Chlorpyrifos residues lower than MRLs (Samaneh, 2004).

The presence of agricultural pesticides residues that have been identified and others in fruits and vegetables is a dangerous indicator. This results indicating that farmers do not adhere apply the correct standards for the use of agricultural pesticides, the absence of checks for fruits and vegetables in the markets and the absence of strict control by the authorities responsible for the use of agricultural pesticides in the West Bank.

The current findings are comparable with the results by Al-Nasir 2020, who showed the presence of many residues in many crops in Jordan valley region. The results confirm the need for adequate training and enforcement of good agricultural practices. Regular inspections and effective monitoring programs of pesticides in irrigation water and fresh produce are also warranted to protect public health (Al-Nasir 2020).

## **4.2 Survey result**

### **4.2.1 Samples characteristics**

The characteristics of the test sample were illustrated in tables 4.3, 4.4, 4.5, 4.6, and 4.7.

#### **4.2.1.1 Gender**

It was observed from table 4.3 that 34% of respondents were female while 66% of respondents were male.

**Table 4.3: Gender of the participants.**

Gender	Percentage
Male	34.1%
Female	65.9%

**4.2.1.2 Age**

From Table 4.4 it was observed that nearly 50% of respondents were in group ages between 30-49 years, followed by 38% in the age group 18-29 years, while 11% of respondents from age group 50 years and above.

**Table 4.4: Age of participants.**

Age	Percentage
Less than 18 year	0.60%
18-29 years	38.2%
30-49 years	50.4%
50 years and above	10.8%

**4.2.1.3 Monthly income**

From table 4.5 it was found that the majority of respondents had monthly income between 2500-4000 shekel followed by income level between 1000-2500 shekel while 18% of respondents more than 4000 shekel and 13% of respondents less than 1000 shekel.

**Table 4.5: The average monthly income of participants.**

Average monthly income (shekel)	Percentage
Less than 1,000	13.4%
1,000-2,500	27.4%
2,500-4,000	41.2%
More than 4,000	18%

#### 4.2.1.4 location

From table 4.6 it was observed that 67% of respondents live in cities, followed by 32% of respondents live in villages, while 3% of respondents live in camps.

**Table 4.6: The location of participants.**

Location	Percentage
City	31.6%
Village	65.6%
Camp	2.8%

#### 4.2.1.5 Governorate

From table 4.7 it was revealed that 43.4% of respondents from Jenin, 24.2% from Nablus, 19.8% from Tulkarm, 5.6% from Qalqilya, 3.6% from Tubas, and 3.4% from Salfit.

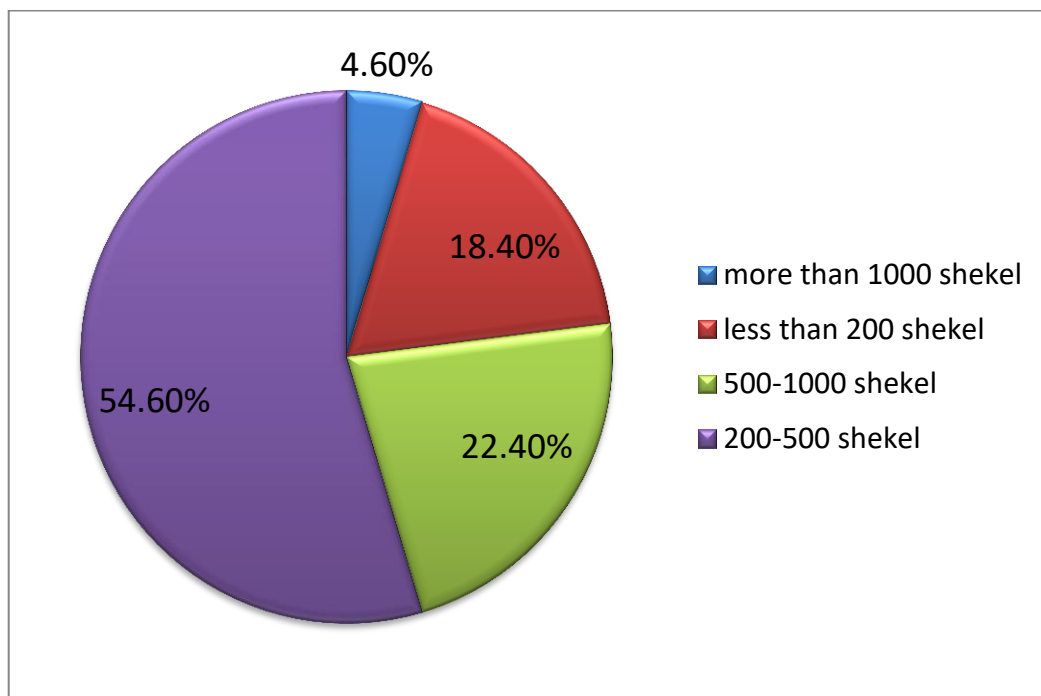
**Table 4.7: Governorates of participants.**

Governorates	Percentage
Jenin	43.4%
Tulkarm	19.8%
Qalqilya	5.6%
Tubas	3.6%
Nablus	24.2%
Salfit	3.4%

## 4.2.2 Consumption of vegetables and fruits

### 4.2.2.1 Monthly consumption value

The monthly consumption value of vegetables and fruits is illustrated in figure 4.4. The largest percentage of vegetables and fruits consumption value was from 200 to 500 shekel per month, constituted nearly 55% of the participants followed by 22% of participants with consumption value 500-1000 shekel while 18% of participants were less than 200 shekel and 5% of participants more than 1000 shekel.



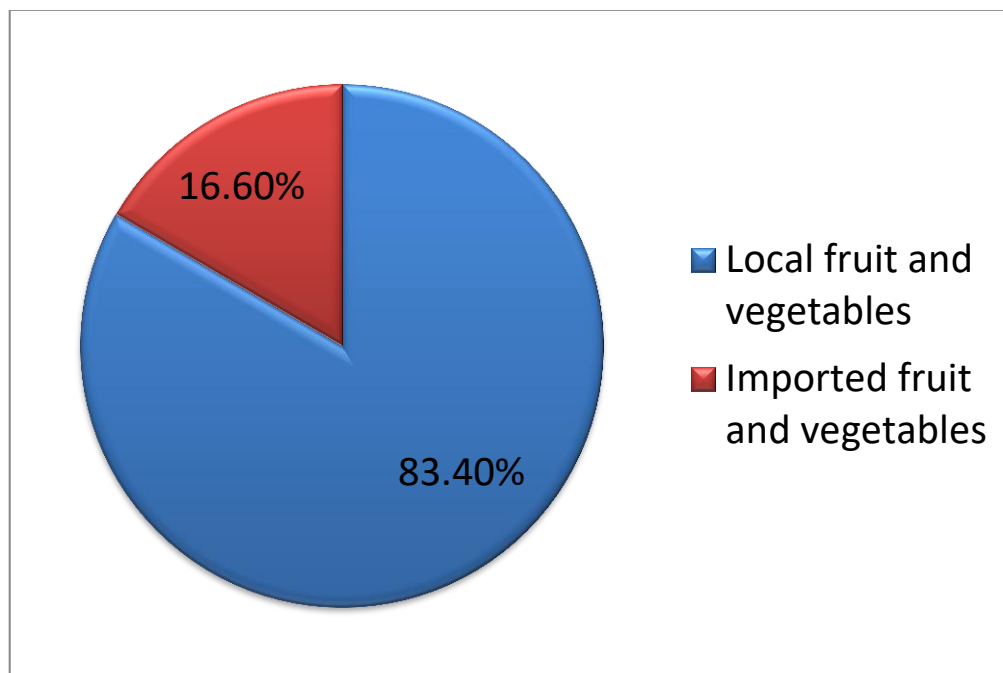
**Figure 4.4:** Monthly consumption value of vegetables and fruits (shekel).

#### 4.2.2.2 Source of fruit and vegetable productions

In this part, vegetables and fruits were divided into local and imported according to their production place; the participants' responses were illustrated in figure 4.5.

Figure 4.8 shows that 83% of respondents prefer to buy local vegetables and fruits while 17% of respondents prefer imported fruit and vegetables.

This is due to the low prices of local products compared to imported products. In addition, most of the imported products are distinguished from the local product and have a label show the products' source.



**Figure 4.5:** Source of fruits and vegetables.

### 4.2.2.3 Knowledge about agricultural pesticide residues and safe agricultural products

The information about agricultural pesticide residues and safe agricultural products is illustrated in table 4.8.

**Table 4.8: Knowledge about agricultural pesticide residues and safe agricultural products.**

Questions	Yes	No
	(%)	(%)
Do you know that there are harmful agricultural pesticide residues in fruits and vegetables?	34.5%	65.5%
Do you feel safe when buying vegetables and fruits available from the local markets?	14.6%	85.4%
Do you think that the farmer in your area is committed to use agricultural pesticides properly and harvest them after they are safe for consumption?	24.4%	75.6%
Do you know safe agricultural products?	36.2%	63.8%
Do you trust agricultural products that are free of pesticide residues in the Palestinian market?	46.8%	53.2%

It was observed from table 4.8 that 34.5% of the respondents were aware that pesticide residues are unsafe for health, whereas 65.5% of respondents were not aware that pesticide residues are unsafe for health. This is due to the lack of awareness these residues' presence in agriculture products and their harmful effects on health and the environment.

It was found that about 14.6% of respondents feel safe when consuming fruits and vegetables from local markets, while 85.4 % of respondents 'don't feel safe when consuming fruits and vegetables from local markets.

It was shown that 24.4% of respondents believe that the farmers use pesticides correctly and adhere to the instructions regarding harvest time, while the remaining 75.6% of respondents 'don't believe that the farmers adhere to the correct standards for pesticide use.

It was noticed that 36.2% of respondents know safe agricultural products while 36.8 % don't know about safe agricultural products.

Finally, 46.8% of respondents trust agricultural products that are free of pesticide residues on the local market, while 53.2% of respondents do not trust agricultural products that are free of pesticide residues on the market. These responses were consistent with a survey conducted by Liu et al (Liu et al, 2013).

#### **4.2.2.4 Consumers' acceptance of the existence of safe agricultural products free of pesticide residues in the Palestinian markets**

The consumers' opinion about safe agricultural products free of pesticide residues in the Palestinian markets is illustrated in table 4.9.

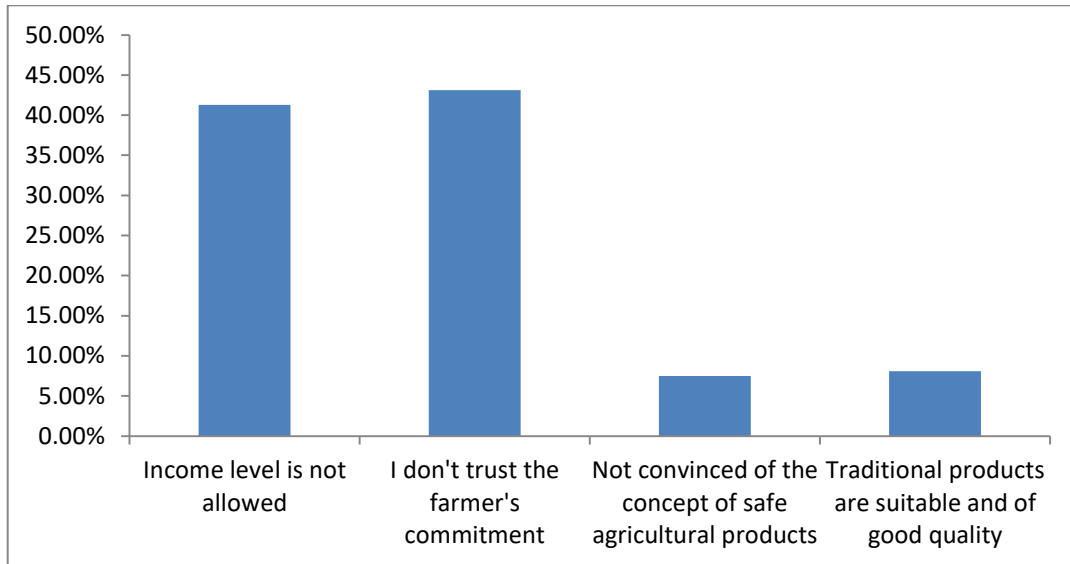
**Table 4.9: consumers' acceptance of the existence of safe agricultural products free of pesticide residues in the Palestinian markets.**

Questions	Yes	No
	(%)	(%)
Do you support the existence of a system that controls the use of agricultural pesticides in Palestine by farmers and examines their products continuously?	<b>92.1%</b>	<b>7.9%</b>
Do you support the presence of certified vegetables and fruits in the local markets which are free of agricultural pesticide residues?	<b>92.3%</b>	<b>7.7%</b>
Are you willing to pay a higher price for buying agricultural products completely free of chemicals?	<b>80%</b>	<b>20%</b>

It was found that 92% of respondents support a monitoring system to monitor farmers' use of agricultural pesticides and forcing them to use good practices, in addition to obtaining a certificate of safe agricultural products. Moreover, it was observed that 80% of the participants were willing to pay a higher price for safe agricultural products, and this is consistent with the results of a study conducted in Myanmar that showed consumers 'desire to pay for environmentally certified products and observed consumers' strong attraction to products bearing a food safety label despite It is more expensive compared to traditional products (Aye, 2019).

About 20% of consumers refuse to pay a higher price to obtain certified agricultural products for various reasons, as illustrated in Figure 4.10. The reason for rejection is that 43.10% of respondents do not trust that farmers adhere to the correct standards of good agricultural practices, 41.3% are their income does not allow to pay a higher price to have these

products, 8.1% are convinced of the traditional products and 7.5% are not convinced of the concept of safe agricultural products.



**Figure 4.6:** Reasons for consumers' refusal to pay a higher price to obtain safe agricultural products.

## 4.2.3 The result of the study hypotheses

### 4.2.3.1 First hypothesis

The first hypothesis says that there is no statistically significant difference between the gender factor with confidence in farmers' products at  $P\text{-value} \leq 0.05$ .

From the statistical analysis in table 4.10, the  $P\text{-value} = 0.03$ , which means rejecting the null hypothesis. There is a significant difference between the gender factor with confidence in farmers' products as illustrated in table 4.11.

**Table 4.10: statically analysis for the first hypothesis**

	value	df	P value
Pearson Chi-Square	6.892	2	0.032
Likelihood Ratio	6.647	2	0.036
N of Valid Cases	500		

**Table 4.11: The influence of gender on the confidence of farmers product**

gender	Do you think that the farmer in your area is committed to properly using agricultural pesticides and picking them after they are safe for consumption?	
	Yes	No
Female	25.8%	74.2%
Male	18.2%	81.8 %
P value	0.032	

It was observed that both male and female do not trust the farmers' product, but it was observed that 81% of men was higher than women. This could be due to those women are less aware of agricultural pesticide residues and indicated that the reason for this is the lack of participation of women in agricultural work. This result is comparable with the results by Saikia et al. that noticed that Women have a medium level of awareness about pesticide residues (Saikia et al, 2011).

#### **4.2.3.2 Second hypothesis**

The second hypothesis says there is no significant difference between the age factor and confidence in the farmers' commitment to using correct standards for pesticide use at P-value  $\leq 0.05$ .

From the statistical analysis in table 4.12, the P-value =0.002, which means rejecting the null hypothesis. There is a significant difference between the age factor and confidence in the farmers' commitment to using correct standards for pesticide use, as illustrated in table 4.13.

**Table 4.12: statically analysis for the second hypothesis**

	value	df	P value
Pearson Chi-Square	14.377	3	0.002
Likelihood Ratio	17.262	3	0.001
N of Valid Cases	500		

**Table 4.13: Age with confidence in the 'farmer's commitment to using correct pesticide use standards.**

Age	Do you think that the farmer in your area is committed to use agricultural pesticides properly and picking them after they are safe for consumption?	
	No	Yes
Less than 18 year	66.7%	33.3%
18-29 years	70.2%	29.8%
30-49 years	77.8%	22.2%
50 years and above	94.4%	5.6%
P value	0.002	

The results showed that the young ages think that the farmer adheres to the correct standards, unlike the older ages who believe that the farmer does not adhere apply the correct practices this agree with the results of a questionnaire applied to farmers, which showed that 97% of farmers do not apply the correct standards for the use of pesticides (Adjrah, 2013).

### 4.2.3.3 Third hypothesis

The third hypothesis says that there is no significant difference between average monthly income factor with the consumers willing to pay a higher price to obtain safe agricultural products at a P-value  $\leq 0.05$

From the statistical analysis in table 4.14, the P-value = 0.00, which means rejecting the null hypothesis. There is a significant difference between the average monthly income factor with the consumers willing to pay a higher price to obtain safe agricultural products, as illustrated in table 4.15.

**Table 4.14: statically analysis for the third hypothesis**

	value	df	P value
Pearson Chi-Square	22.835	3	0.000
Likelihood Ratio	24.044	3	0.000
N of Valid Cases	500		

**Table 4.15: Average monthly income with the consumer's willingness to pay a higher price for purchasing chemical-free agricultural products**

Average monthly income (shekel)	Are you willing to pay a higher price for purchasing chemical-free agricultural products instead of buying traditional agricultural products that use chemicals during the cultivation process?	
	No	Yes
Less than 1,000	32.8%	67.2%
1,000-2,500	29.2%	70.8%
2,500-4,000	17.0%	83.0%
More than 4,000	7.8%	92.2%
P value	0.000	

The results showed that the higher income rate, the 'consumer's ability to pay a higher price to obtain safe agricultural products. This corresponds to a study conducted in Germany that showed an increase in the demand for healthy foods with increased consumer income (Singhal, 2017).

#### 4.2.3.4 Fourth hypothesis

The fourth hypothesis says there is no significant difference between age factors with the consumers willing to pay a higher price to obtain safe agricultural products at  $P\text{-value} \leq 0.05$ .

From the statistical analysis in Table 4.16, the  $P\text{-value} = 0.023$  which means the reject of the null hypothesis. There is a significant difference between age factor with the consumers willing to pay a higher price to obtain safe agricultural products illustrated in the table 4.17.

**Table 4.16: statically analysis for the fourth hypothesis**

	value	df	P value
Pearson Chi-Square	9.568	3	0.023
Likelihood Ratio	8.795	3	0.032
N of Valid Cases	500		

**Table 4.17: Age with the consumer's willingness to pay a higher price to obtain safe agricultural products**

Age	Are you willing to pay a higher price for purchasing chemical-free agricultural products instead of buying traditional agricultural products that use chemicals during the cultivation process?	
	No	Yes
Less than 18 year	66.7%	33.3%
18-29 years	25.7%	74.3%
30-49 years	18.3%	81.7%
50 years and above	13.0%	87.0%
P value	0.023	

The results showed that the greater the age, the greater the 'consumer's ability to pay a higher price in exchange for obtaining safe agricultural products.

This result is consistent with Vidogbéna et al, which showed that all consumers are willing to pay a price premium in exchange for obtaining safe agricultural products. It has been observed that the elderly and highly educated consumers are more willing to pay (Vidogbéna et al, 2015).

#### **4.2.3.5 Fifth hypothesis**

The fifth hypothesis says there is no significant difference between age factor with confidence in agriculture products free of pesticide residues in the Palestinian markets at P-value  $\leq 0.05$ .

From the statistical analysis in Table 4.18, the P-value =0.001, which means rejecting the null hypothesis. There is a significant difference between age factor with confidence in agriculture products free of pesticide residues in the Palestinian markets, as illustrated in table 4.19.

**Table 4.18: statically analysis for the fifth hypothesis**

	value	df	P value
Pearson Chi-Square	17.720	3	0.001
Likelihood Ratio	18.206	3	0.000
N of Valid Cases	500		

**Table 4.19: Age with confidence in agricultural products free of pesticide residues in the Palestinian market.**

Age	Do you trust agricultural products free of pesticide residues in the Palestinian market?	
	No	Yes
Less than 18 year	66.7%	33.3%
18-29 years	43.5%	56.5%
30-49 years	56.0%	44.0%
50 years and above	74.1%	25.9%
P value	0.001	

The results showed that the age group from 18 to 30 is the most confident in safe products and that the age group over 50 years is the least confident in these products. These responses were consistent with a survey conducted by liu et al (Liu et al, 2013).

## Chapter Five

### Conclusion and Recommendations

#### 5.1 Conclusions

This study shows these conclusions:

- There is no pesticide residue in all imported and tested (30 samples) grape, cherry tomato, and sweet pepper that have been checked by GC/MS chromatography.
- Penconazole and Chlorpyrifos residues were found in three local grape production samples from 10 tested samples.
- Imported agricultural products are safer than local agricultural products.
- Large numbers of consumers are not aware about the existence of safe agricultural products and about the Impact of misuse of pesticides.
- Palestinian consumers support the existence of safe agricultural products in the markets, and 80% of them are willing to pay a higher price for these products, besides, to the need for a system that controls and regulate the use of pesticides and obliges farmers to examine their products before marketing them.
- The elderly group is the most concerned with safe food products free from pesticide residues.

- The occupation makes the control of the entrance and agricultural pesticides in the West Bank very difficult.
- There are no quality checks for local and imported agriculture products in the markets.
- There are insufficient facilities to examine pesticide residues in the product in West Bank and the shortage of experts.
- The cost of inspecting pesticide residues is very high for each sample.
- The lack of studies and research specialized in using pesticides in Palestine.

## **5.2 Recommendations**

According to the results, recommendations are suggested to develop local regulations and systems for monitoring the quality of the fruits and vegetables in Palestine.

- Monitor farmers' use of pesticides and make them aware of the harmful effects of pesticide residues on health and the environment
- Encouraging farmers to use good agricultural practices and providing the necessary support for their application and marketing of their products
- Continuous quality testing for local and imported agricultural products.
- Encouraging consumers to buy safe agriculture products.

- Focusing on conducting specialized research in studying the use of pesticides and their residues in crops.
- Providing specialized laboratories for testing residues at a low financial cost.

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## Appendix

## Appendix 1:the questionnaire

استبانة حول المنتجات الزراعية الآمنة في الأسواق الفلسطينية

1- الجنس:

أنثى  ذكر

2- العمر:

أقل من 18 سنة  18-29 سنة   
 30-49 سنة  50 سنة فأعلى

3- المحافظة:

محافظة جنين  محافظة طولكرم   
 محافظة طوباس  محافظة قلقيلية   
 محافظة نابلس  محافظة سلفيت

4- معدل الدخل الشهري:

أقل من 1000 شيقل  1000-2500 شيقل   
 2500-4000 شيقل  أكثر من 4000 شيقل

5- مكان السكن:

المدينة  القرية  المخيم

6- قيمة الاستهلاك الشهري من الخضراوات والفواكه:

أقل من 200 شيقل  200-500 شيقل   
 500-1000 شيقل  أكثر من 1000 شيقل

7- هل لديك معرفة مسبقة بوجود متبقيات مبيدات زراعية في الخضراوات والفواكه؟

نعم  لا

8- هل تشعر بالأمان عند تناول الخضراوات والفواكه التي تم استخدام المبيدات الزراعية في زراعتها؟

نعم  لا

9- هل تعتقد بأن المزارع في منطقتك يلتزم باستخدام المبيدات الزراعية بشكل سليم ويقطفها بعد ان تكون امنة للاستهلاك؟

نعم  لا

10- هل لديك معرفة بالمنتجات الزراعية الآمنة؟

نعم  لا

11- مكان شراء الخضراوات والفواكه؟

الباعة المتجولين  الحسبة

المزارع مباشرة  البسطات

محلات مخصصة لبيع الخضراوات والفواكه

12- أي الانواع التالية تفضل عند شراء الفواكه والخضراوات؟

الفواكه والخضراوات المنتجة محليا

الفواكه والخضراوات المستوردة

13- هل تثق بالمنتجات الزراعية الخالية من بقايا المبيدات الزراعية في الاسواق الفلسطينية؟

نعم  لا

14- هل تؤيد وجود نظام رقابة على استخدام المبيدات الزراعية في فلسطين من قبل المزارعين وفحص منتجاتهم بشكل مستمر؟

نعم  لا

15- هل تؤيد وجود خضراوات وفواكه في الأسواق الفلسطينية تحمل شهادة تبين خلوها من مخلفات المبيدات الزراعية؟

نعم  لا

16- هل لديك استعداد لدفع فرق في السعر مقابل شراء منتجات زراعية خالية تماماً من المواد الكيماوية بدلاً من شراء المنتجات الزراعية التي يتم استخدام المواد الكيماوية فيها أثناء عملية الزراعة؟

نعم  لا

17- إذا كانت اجابتك عن السؤال السابق ( لا ) ذلك يعود الى :

مستوى الدخل لا يتناسب مع سعر المنتج الزراعي الآمن

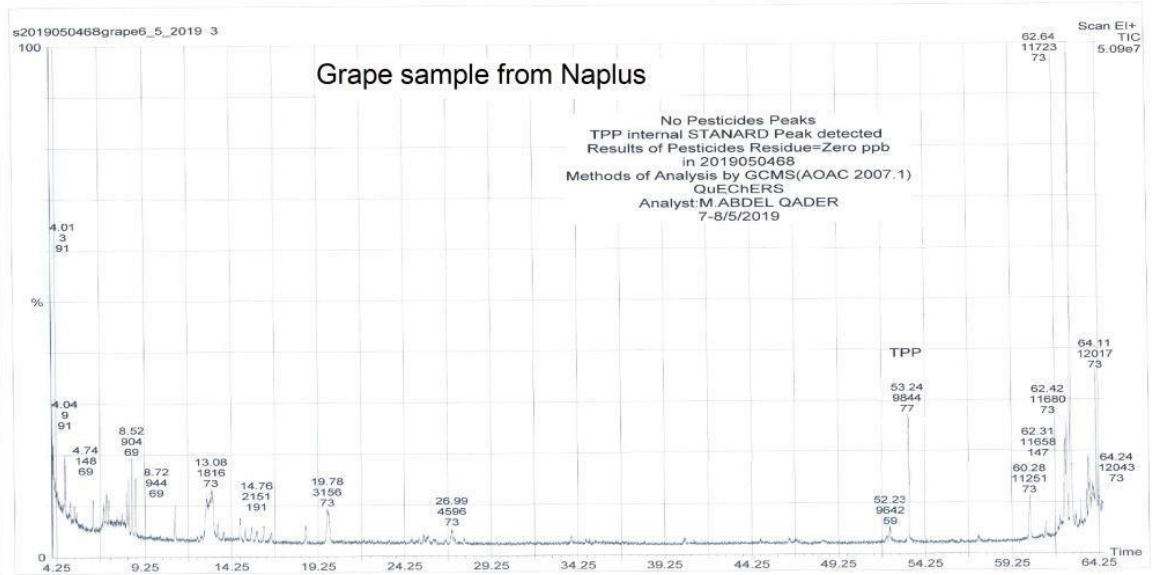
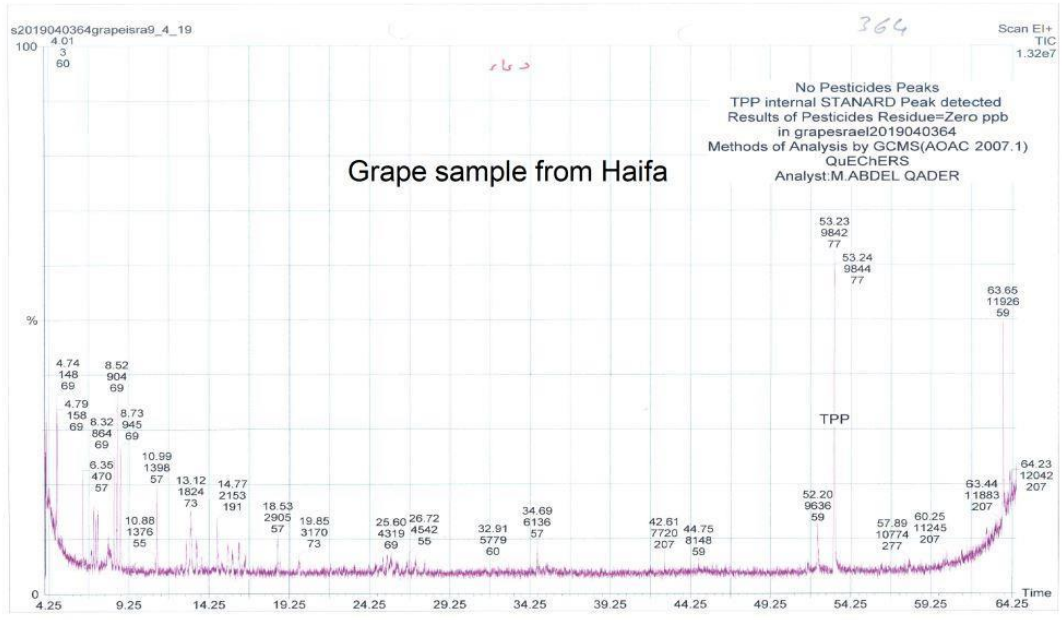
المنتجات التقليدية ذات جودة ومناسبة لمستوى الدخل

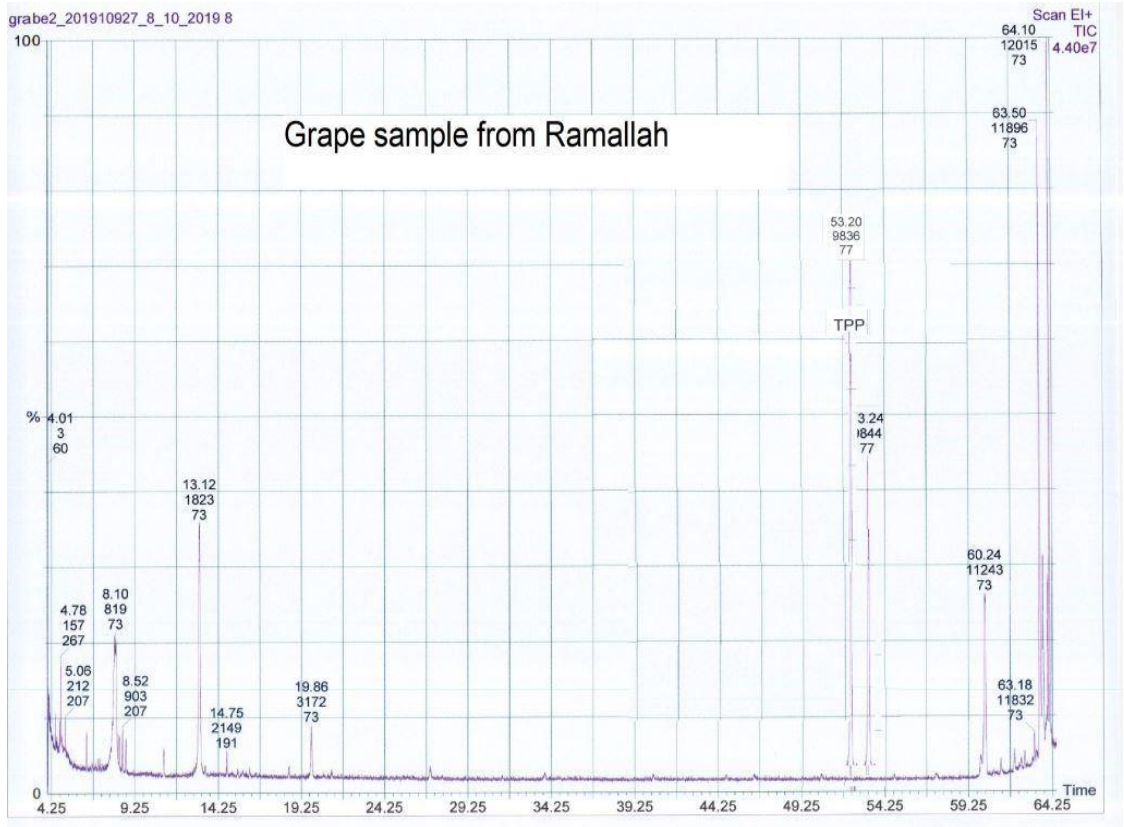
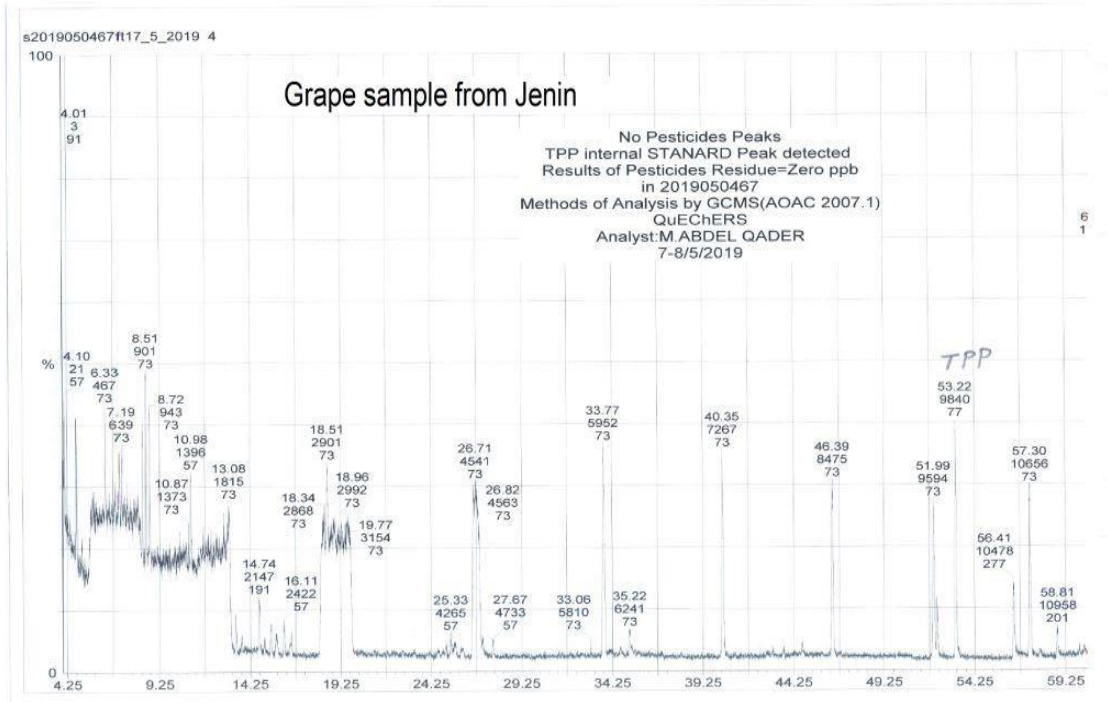
غير مقتنع بمفهوم الزراعة الآمنة

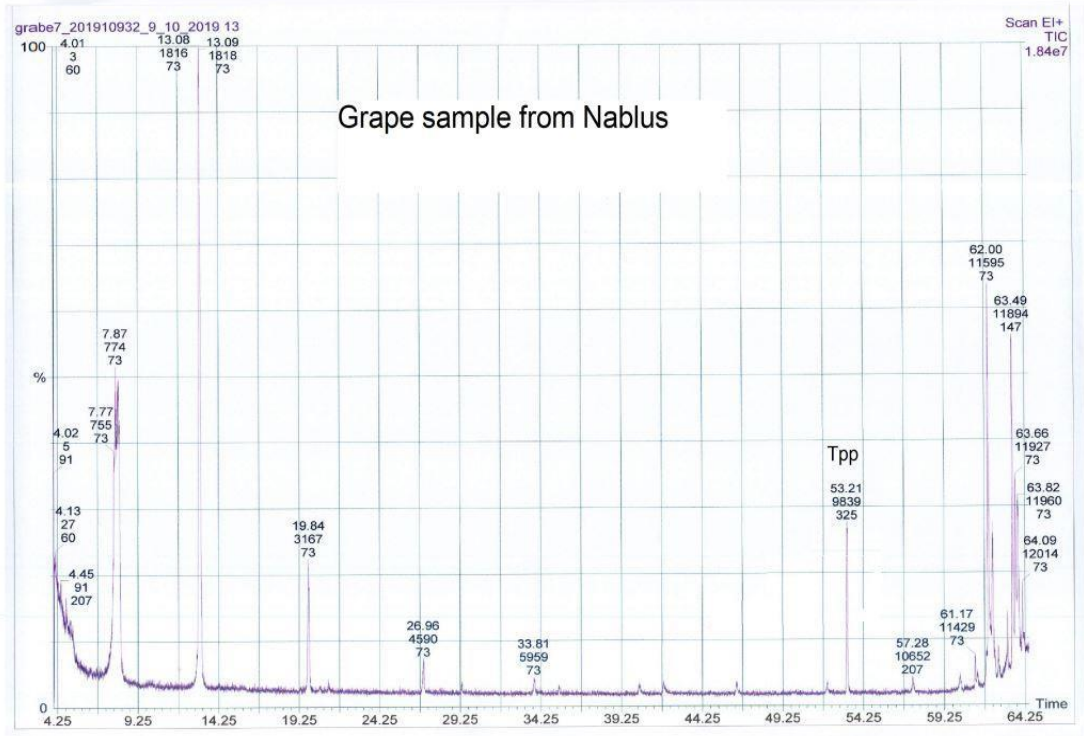
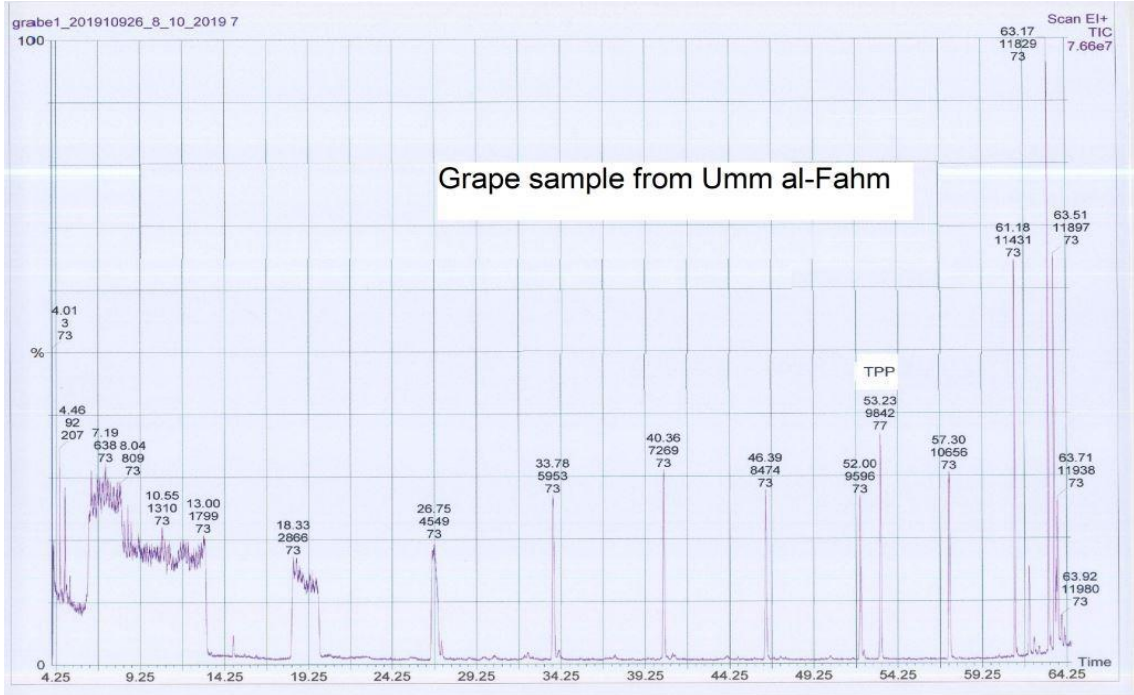
لا أتق بالتزام المزارع بمعايير الزراعة الآمنة

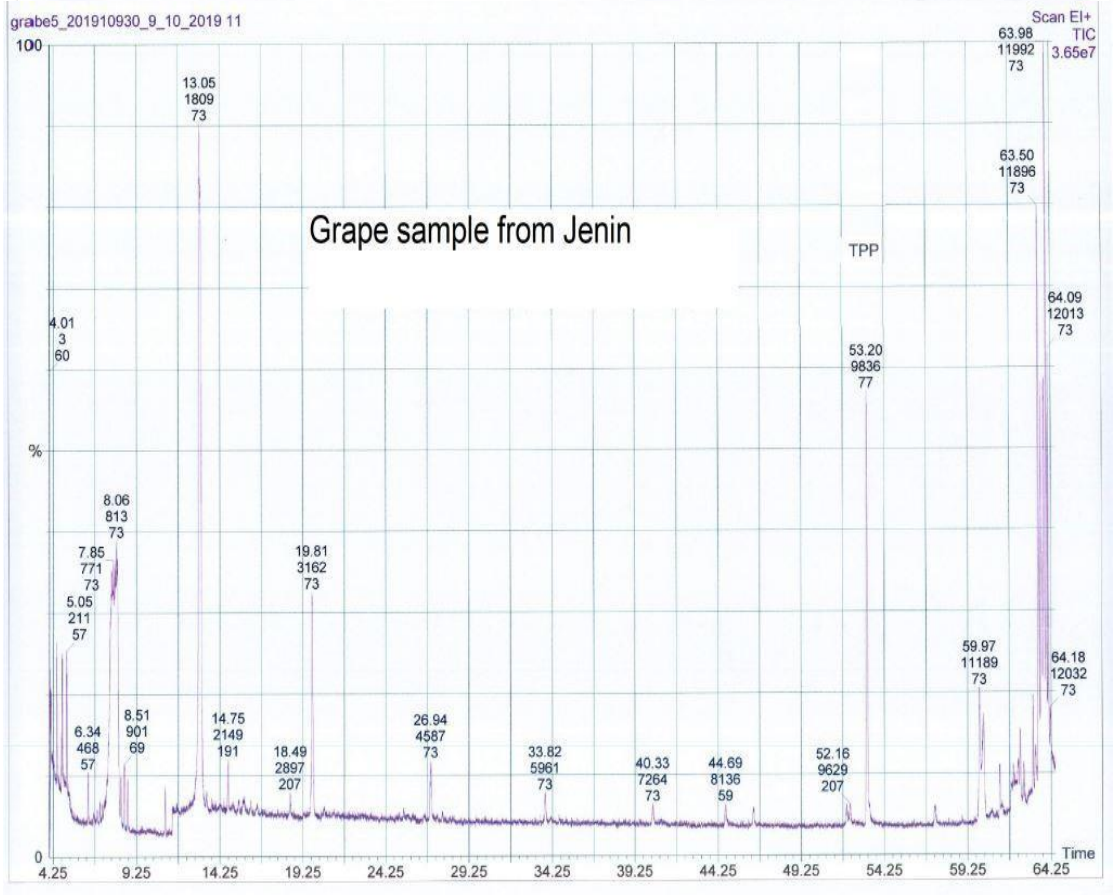
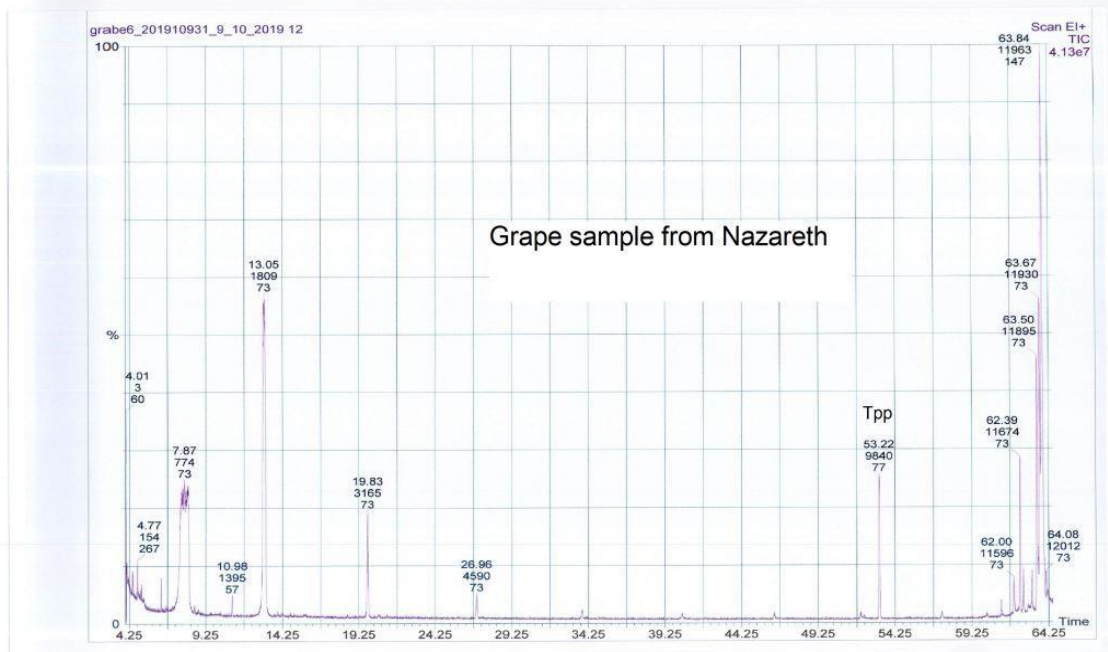
## Appendix 2: Results of sample analysis

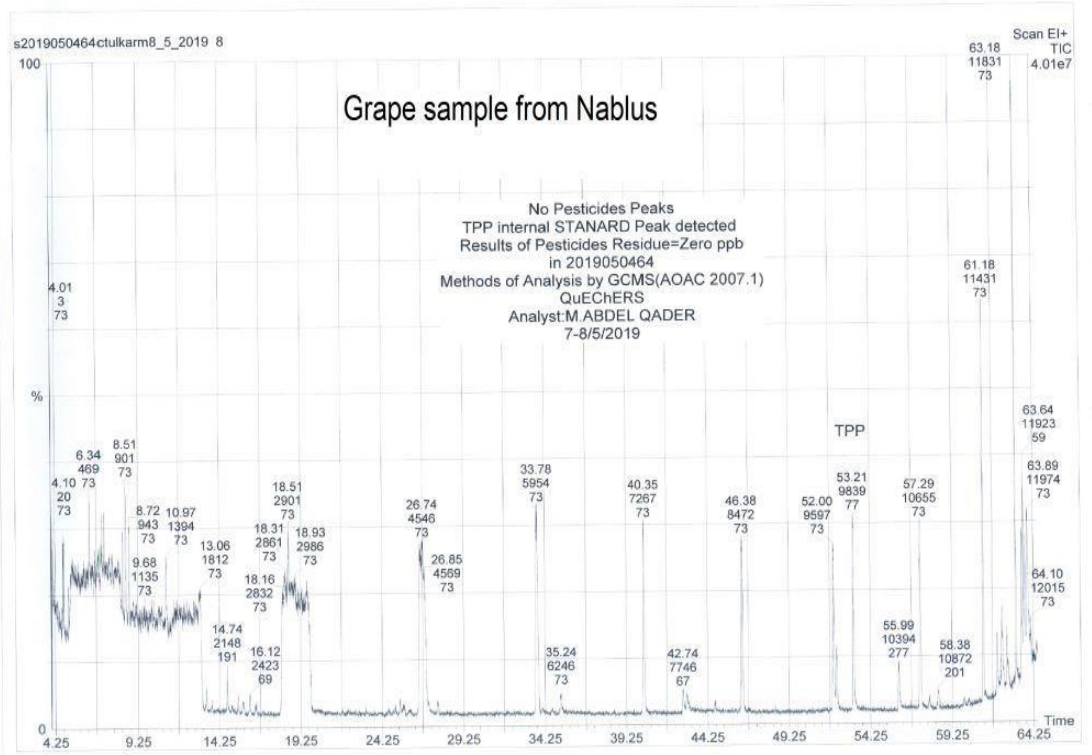
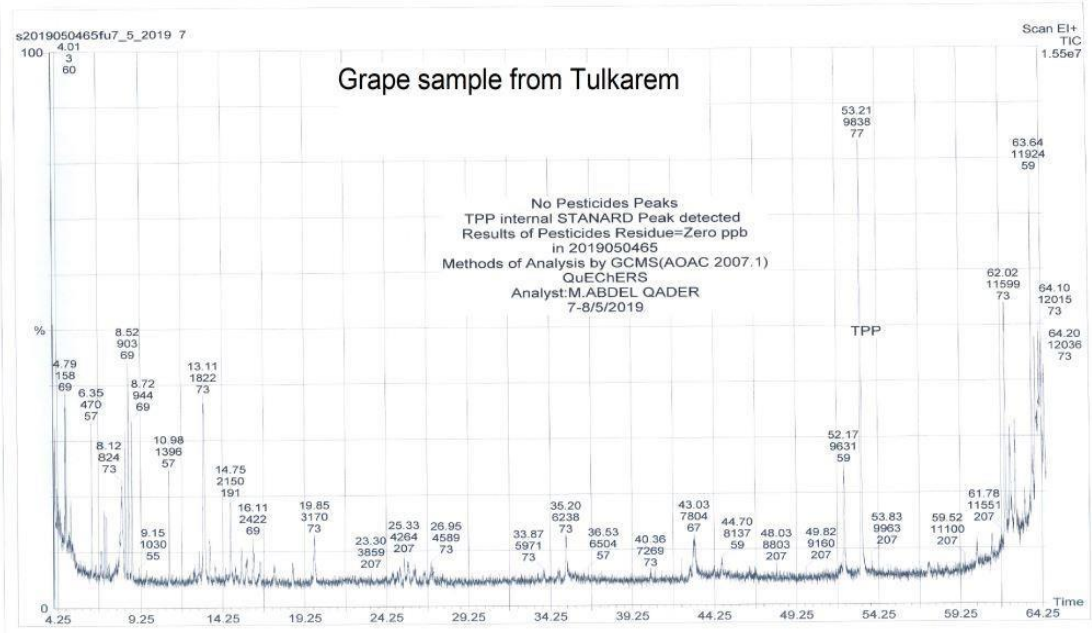
### 1. Imported Grape samples

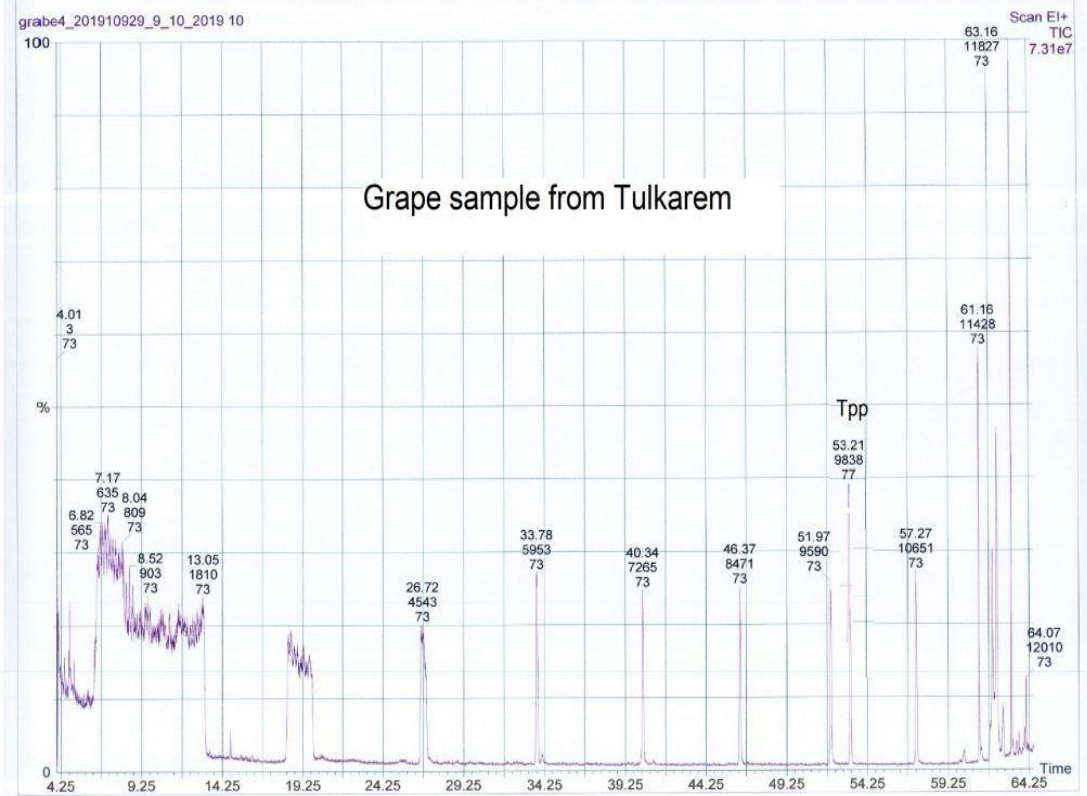
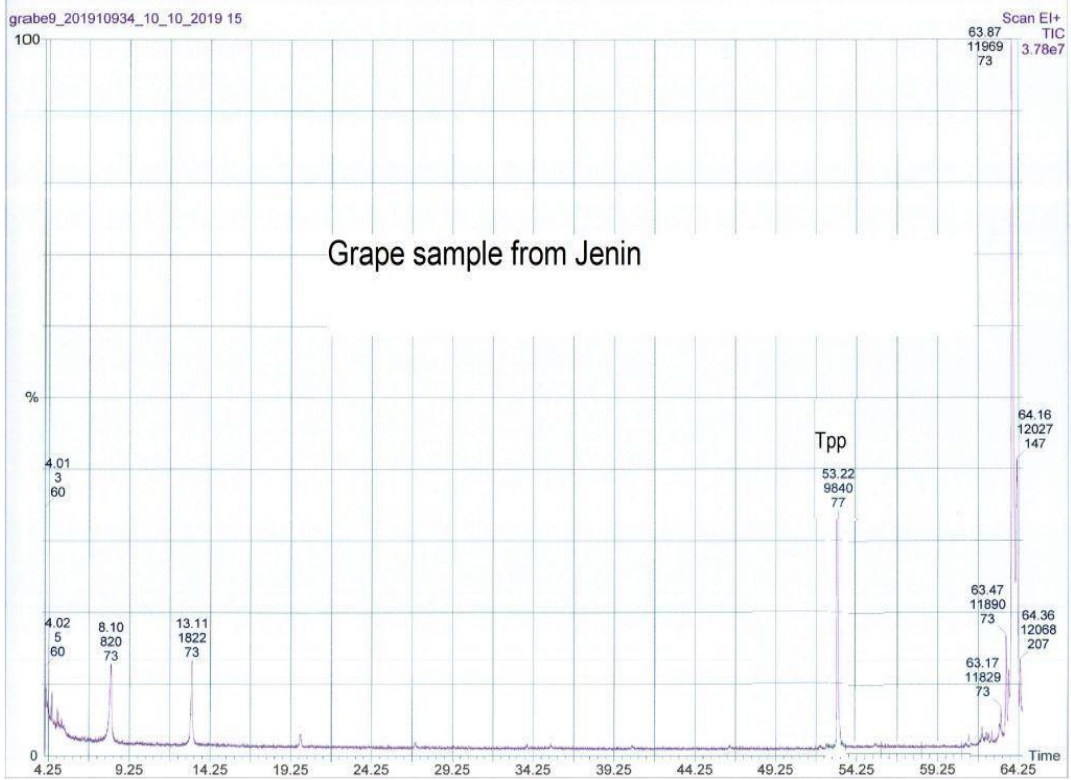


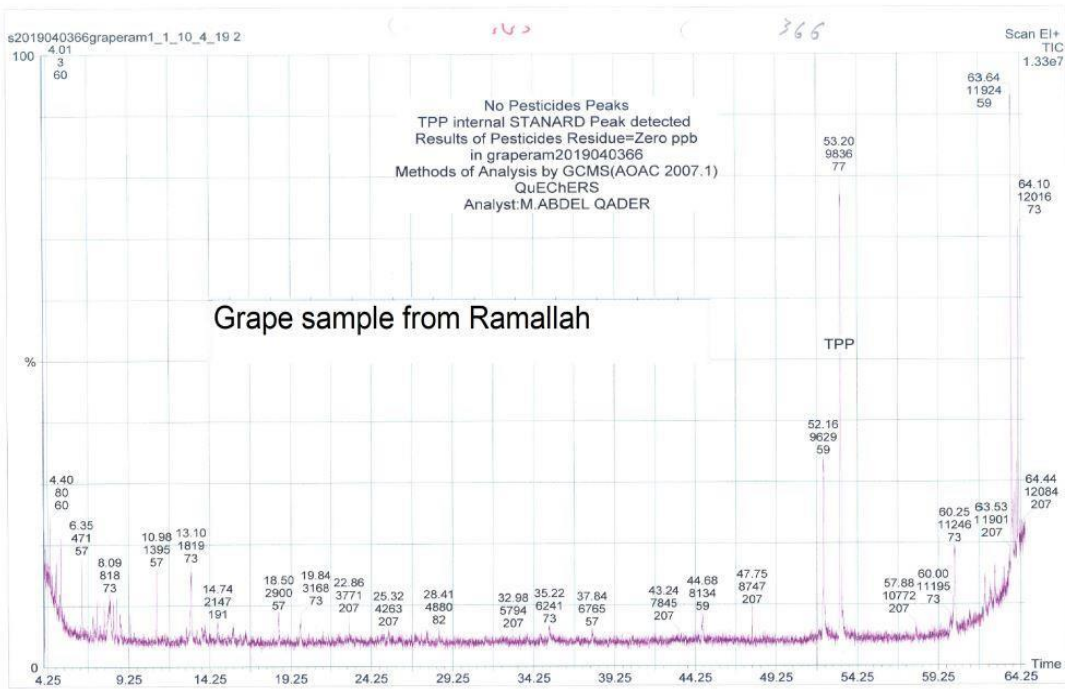
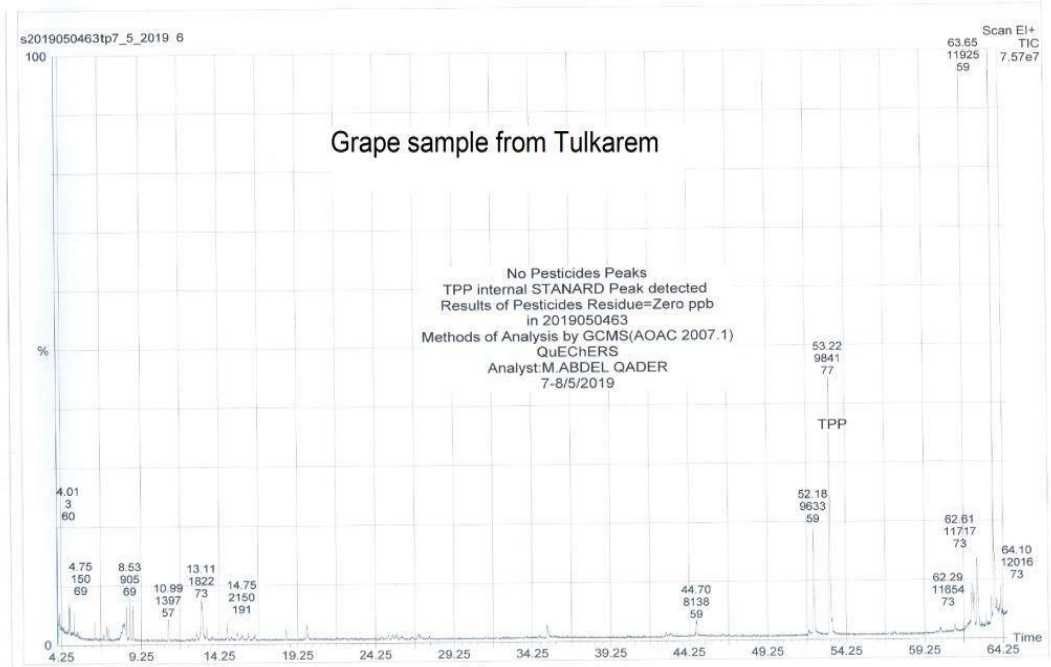


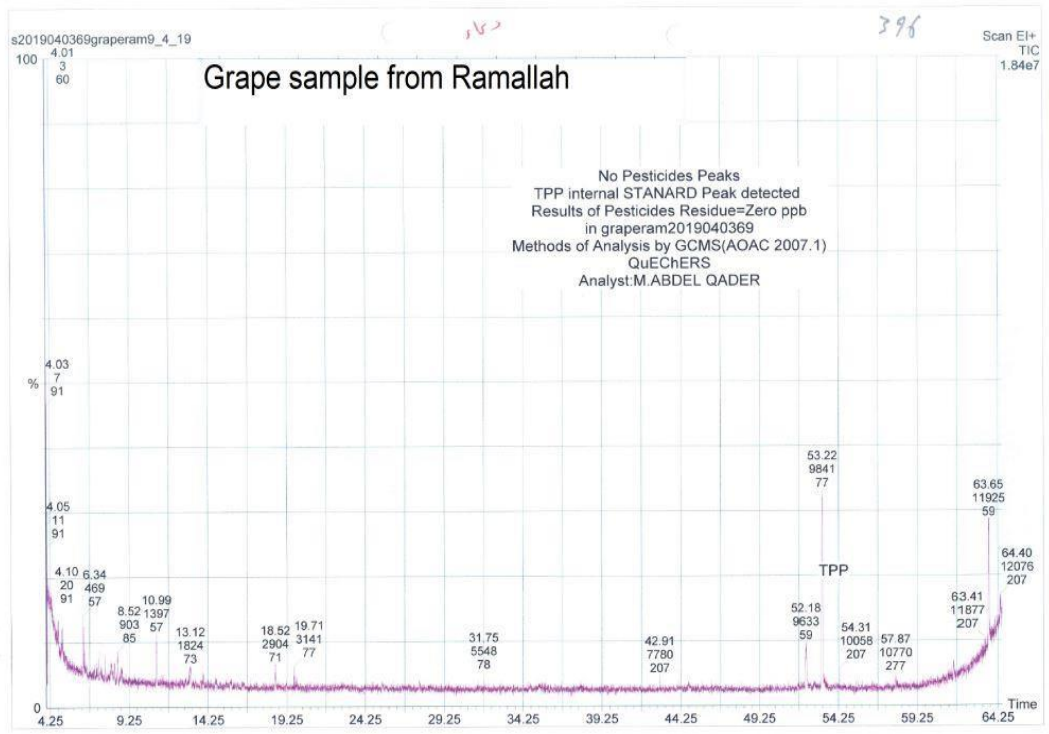




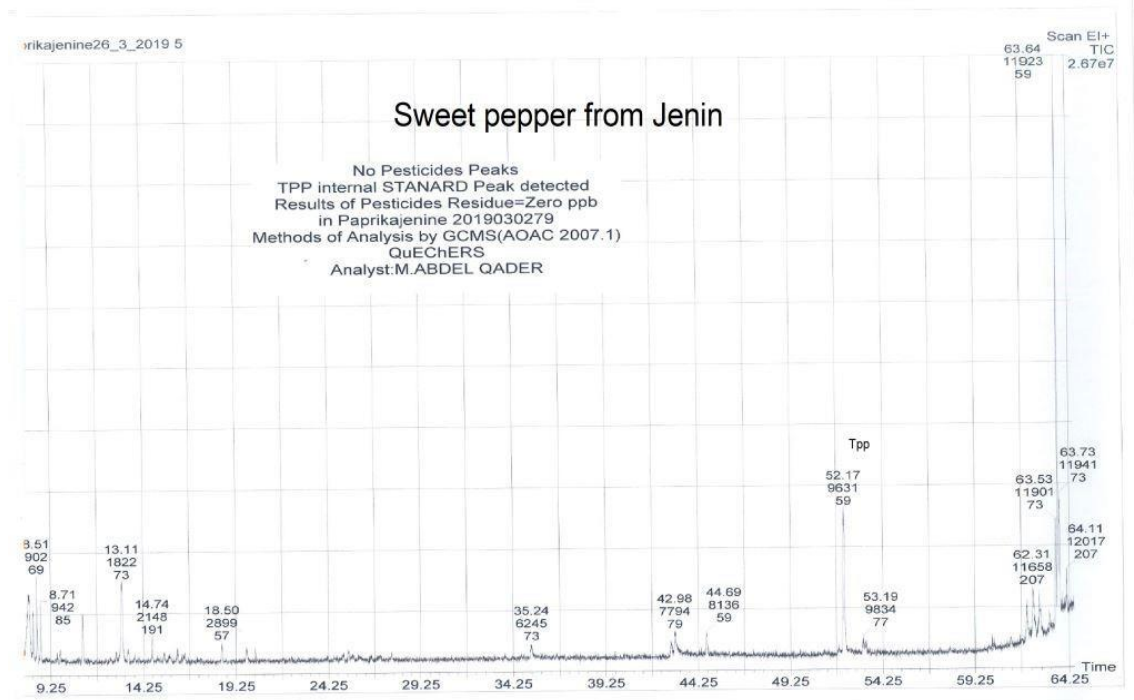
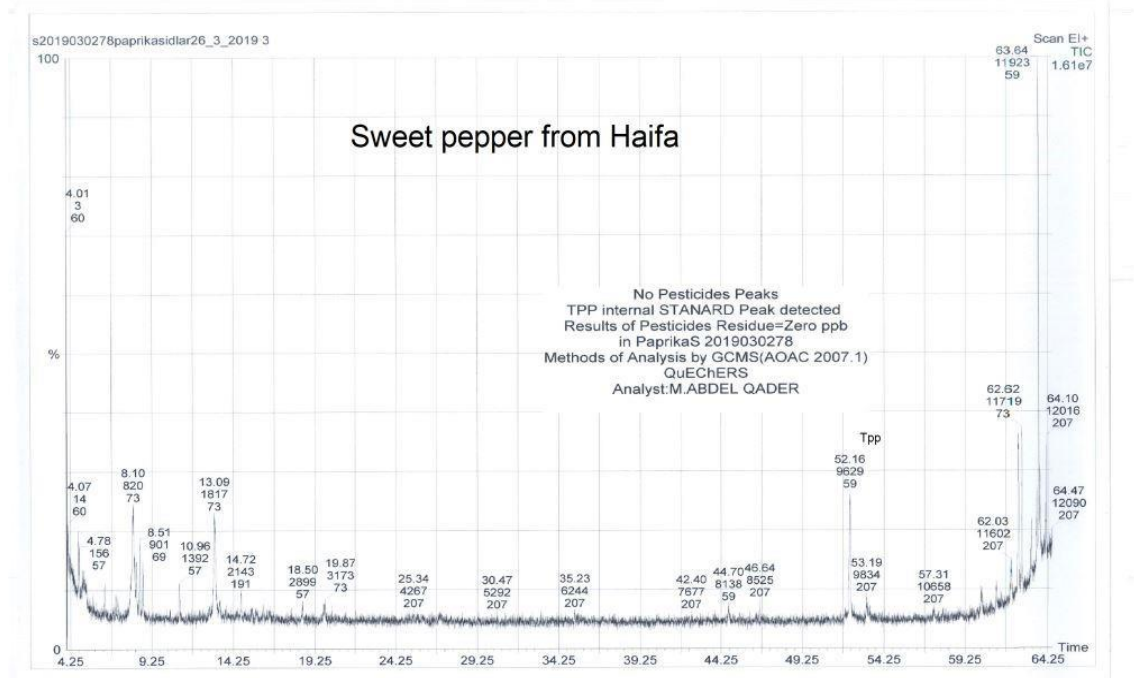


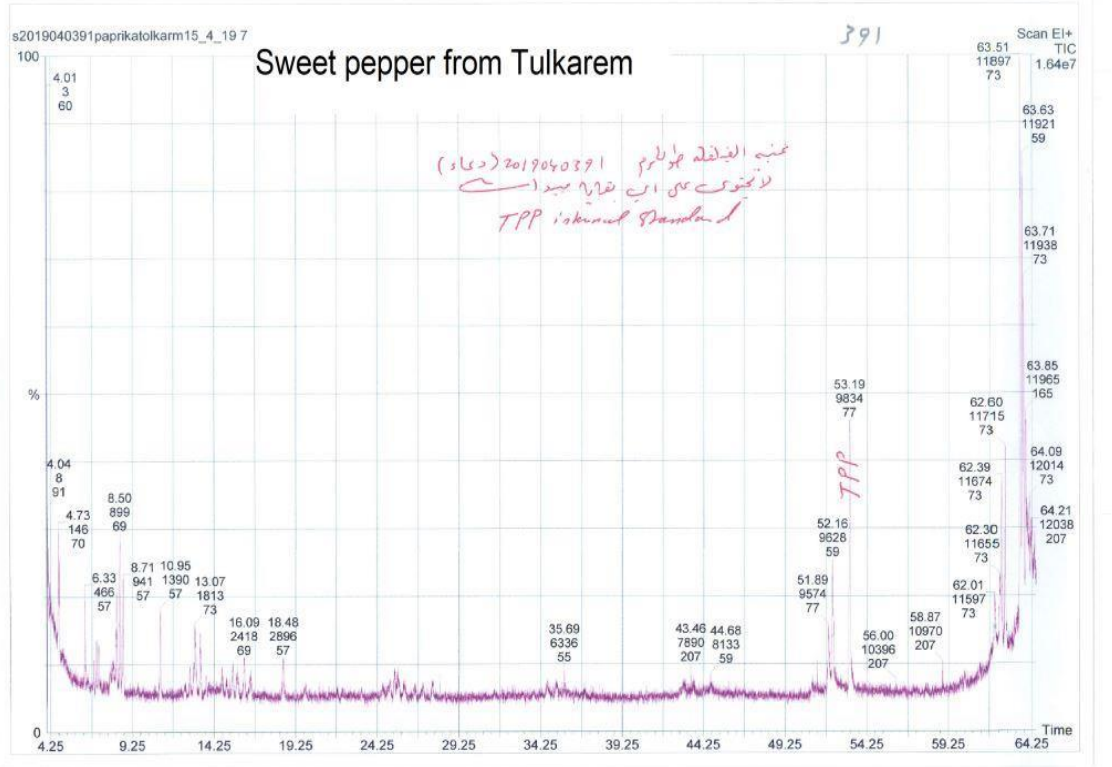
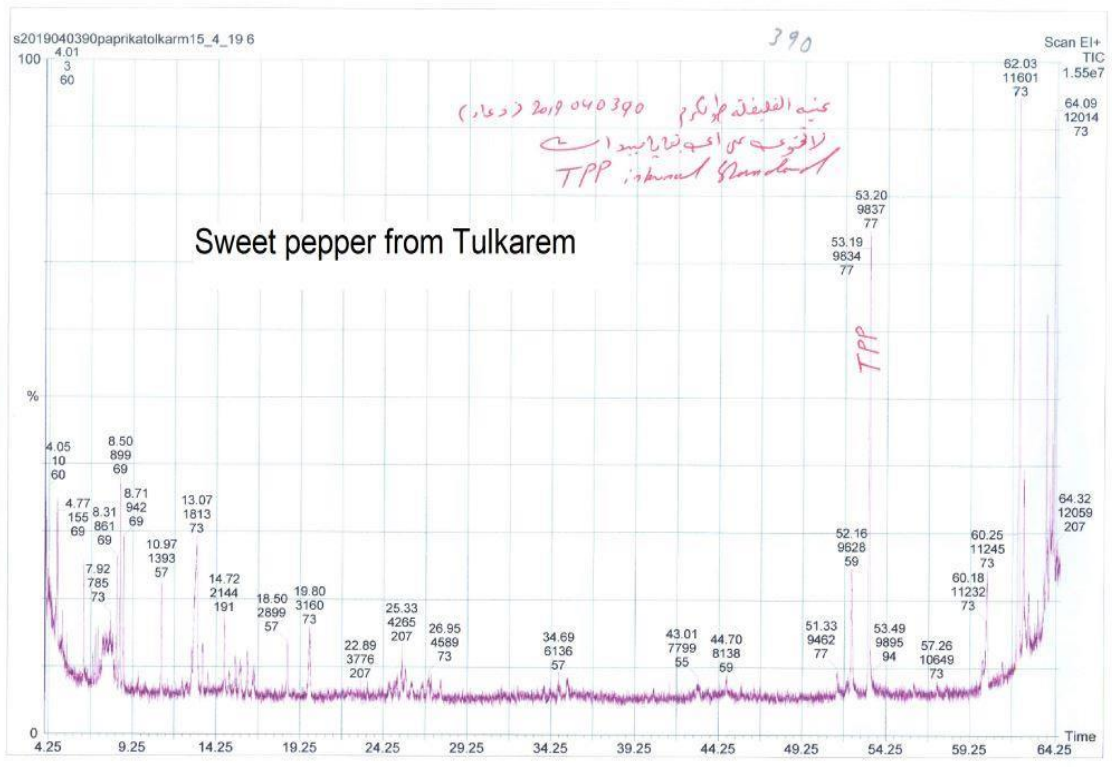


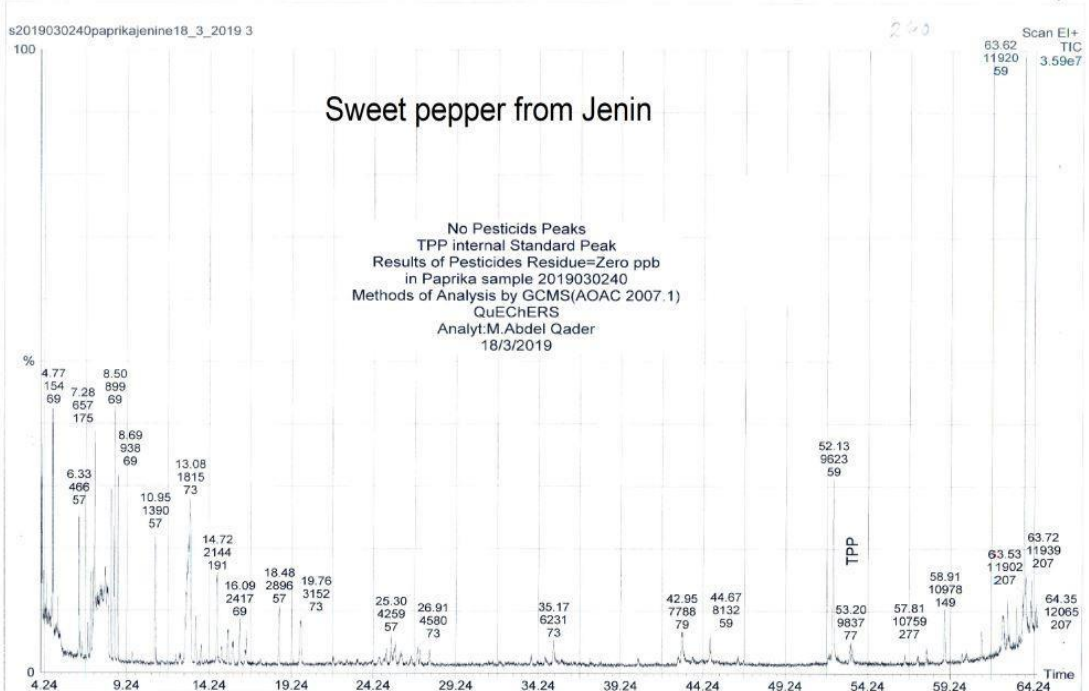
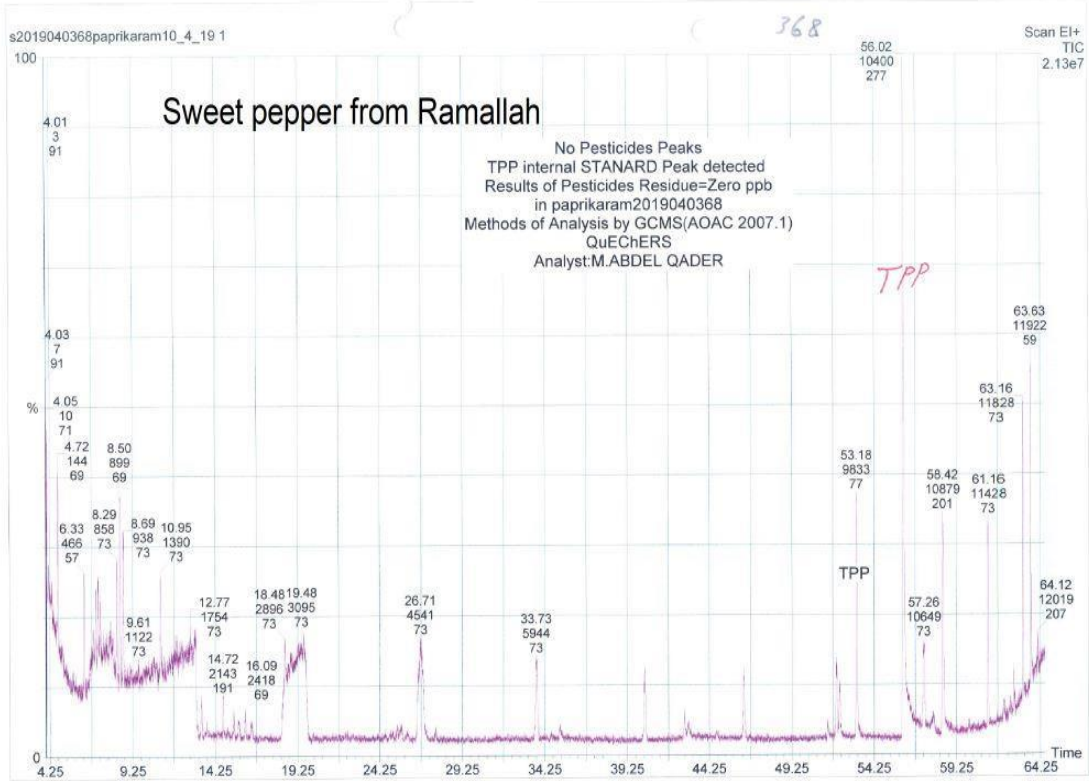


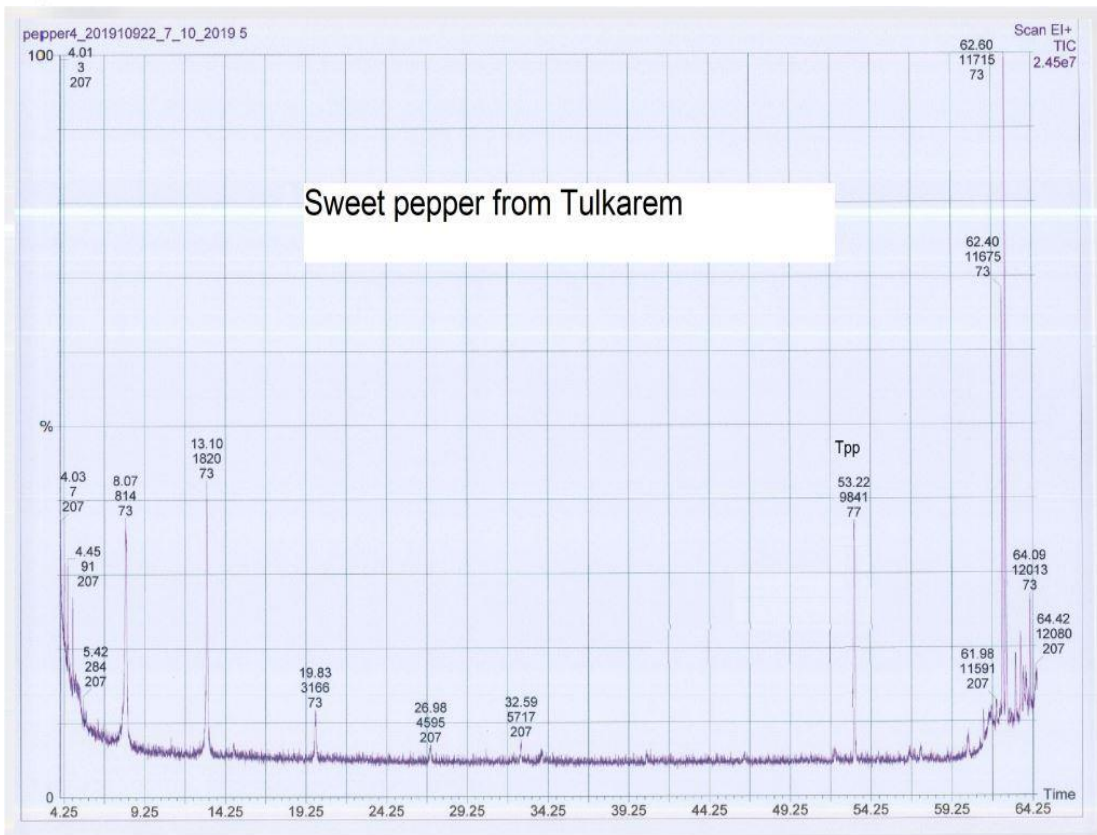
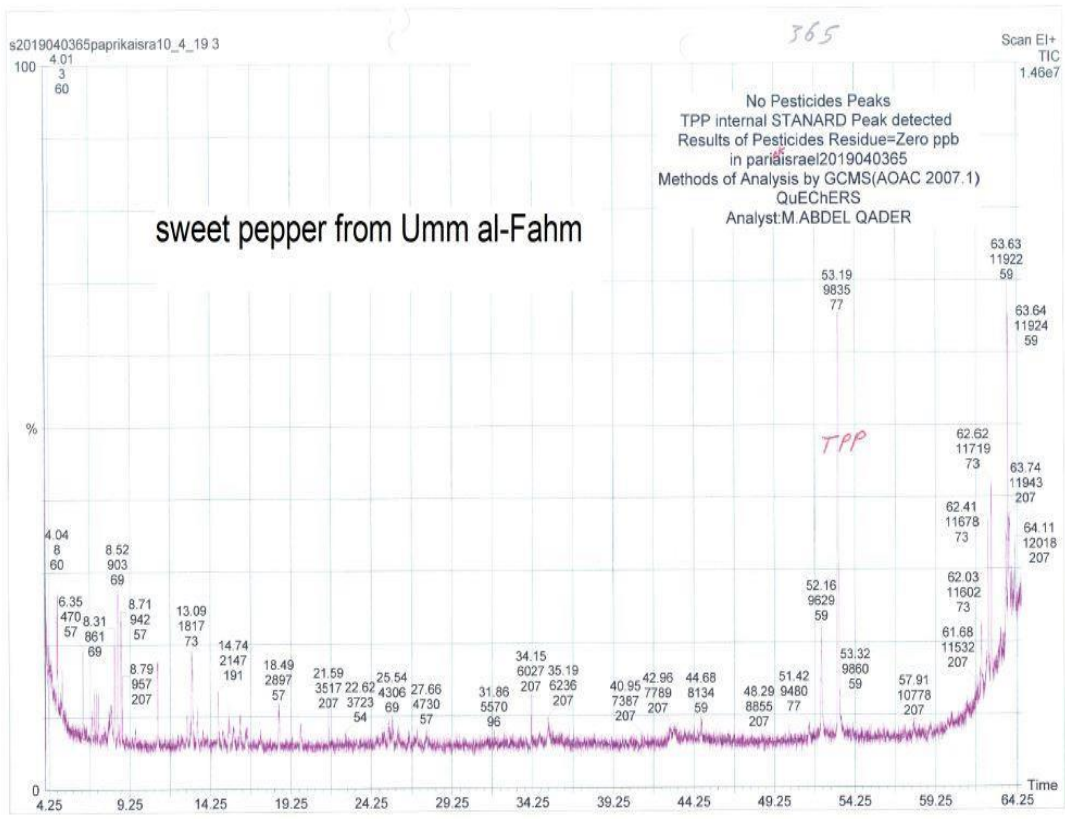


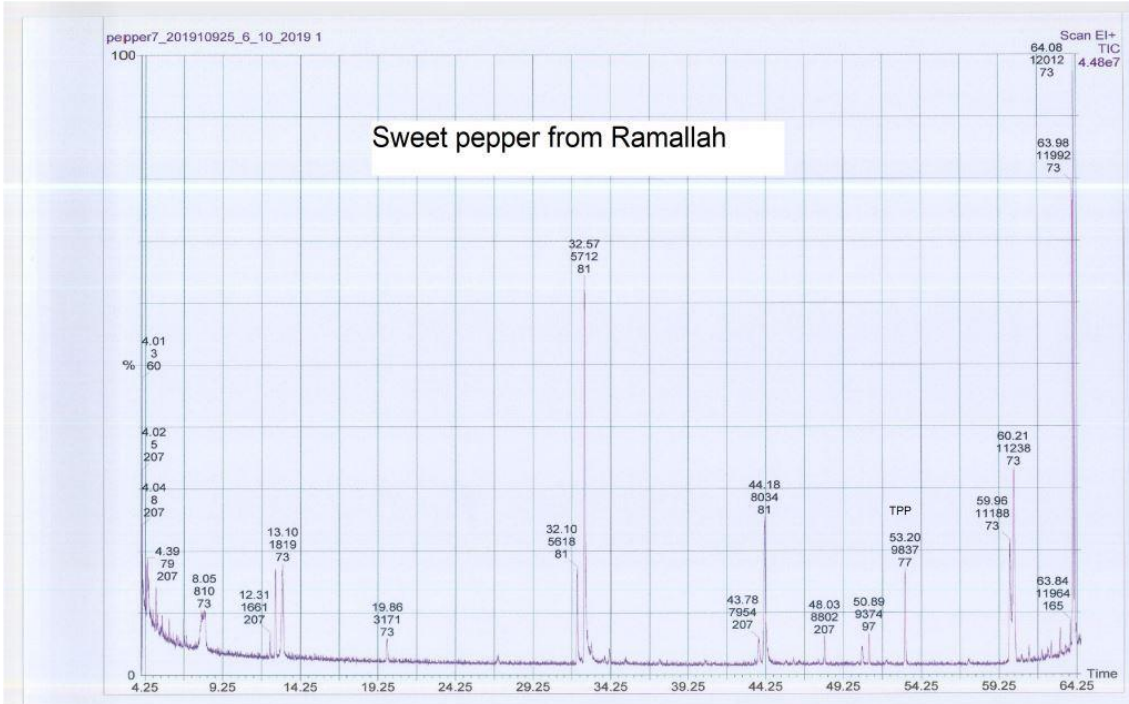
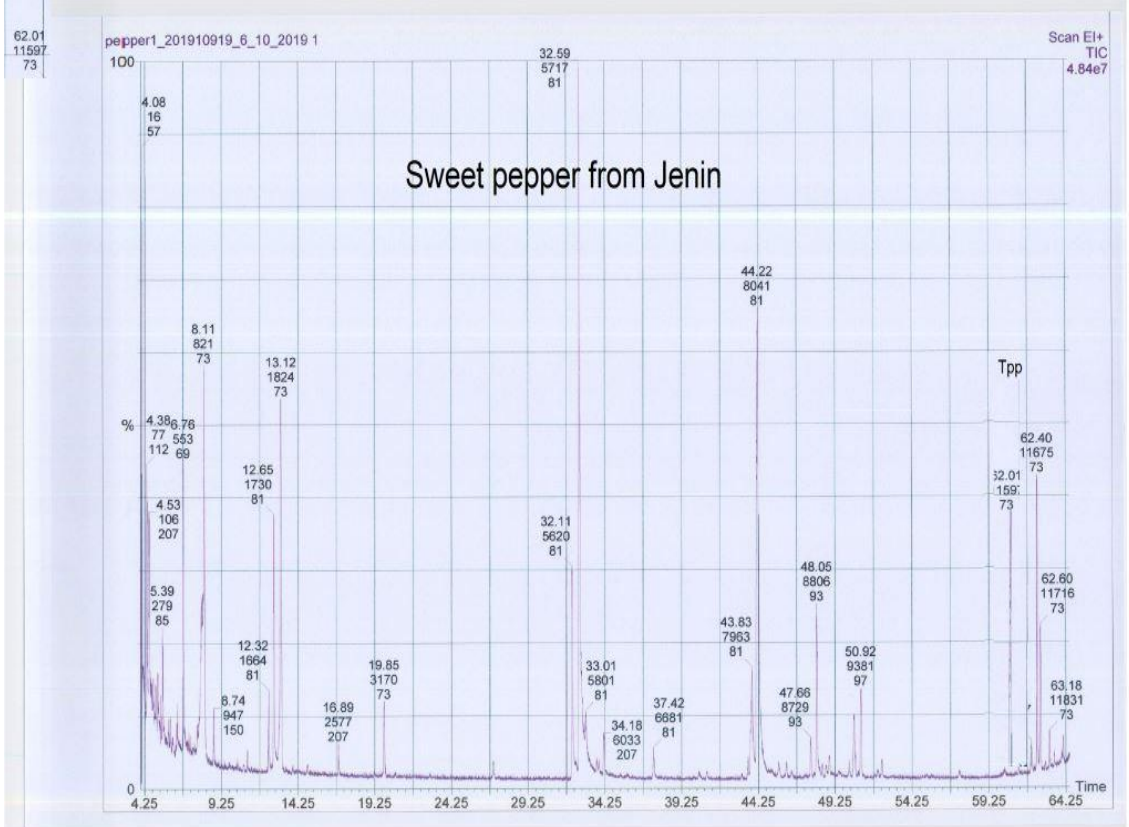
## 2. Imported Sweet pepper samples

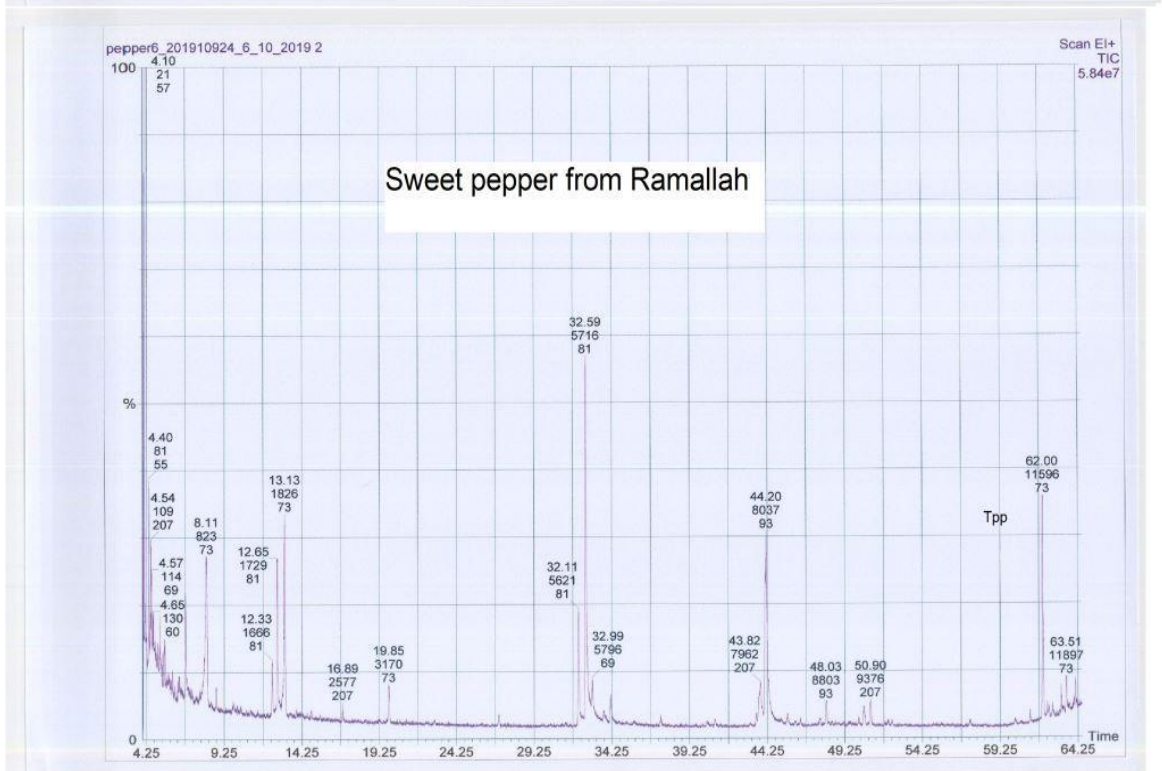
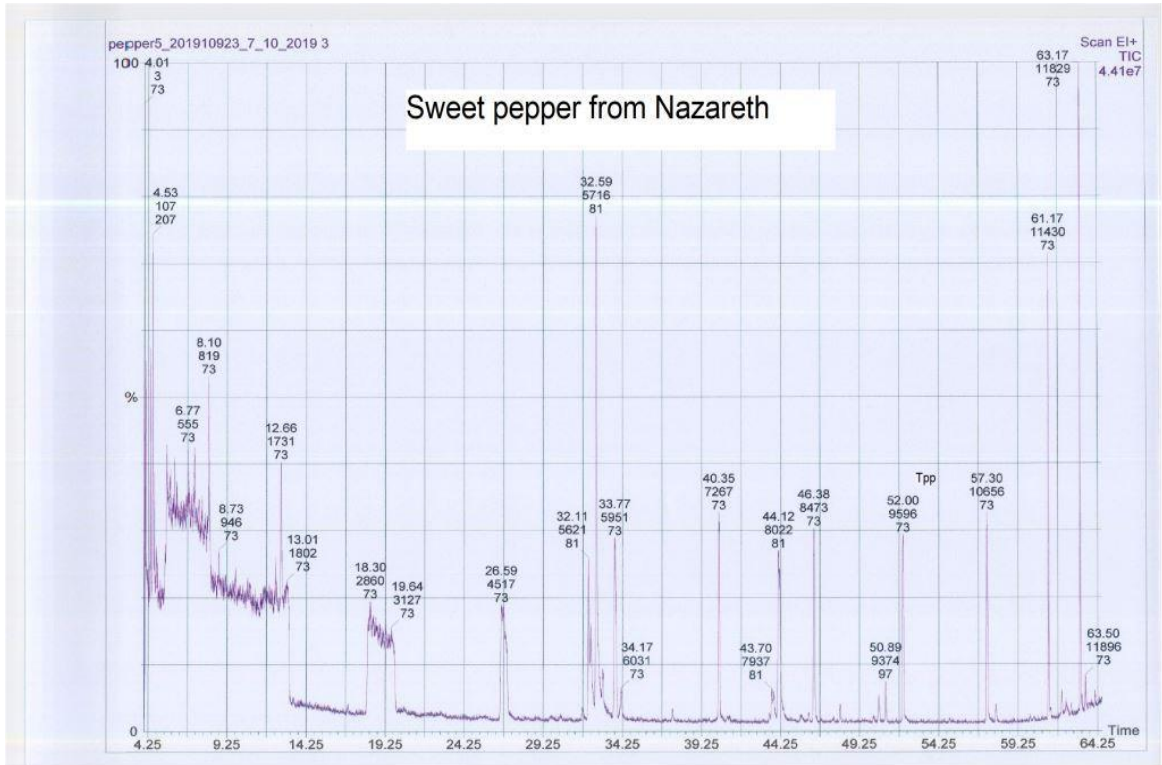


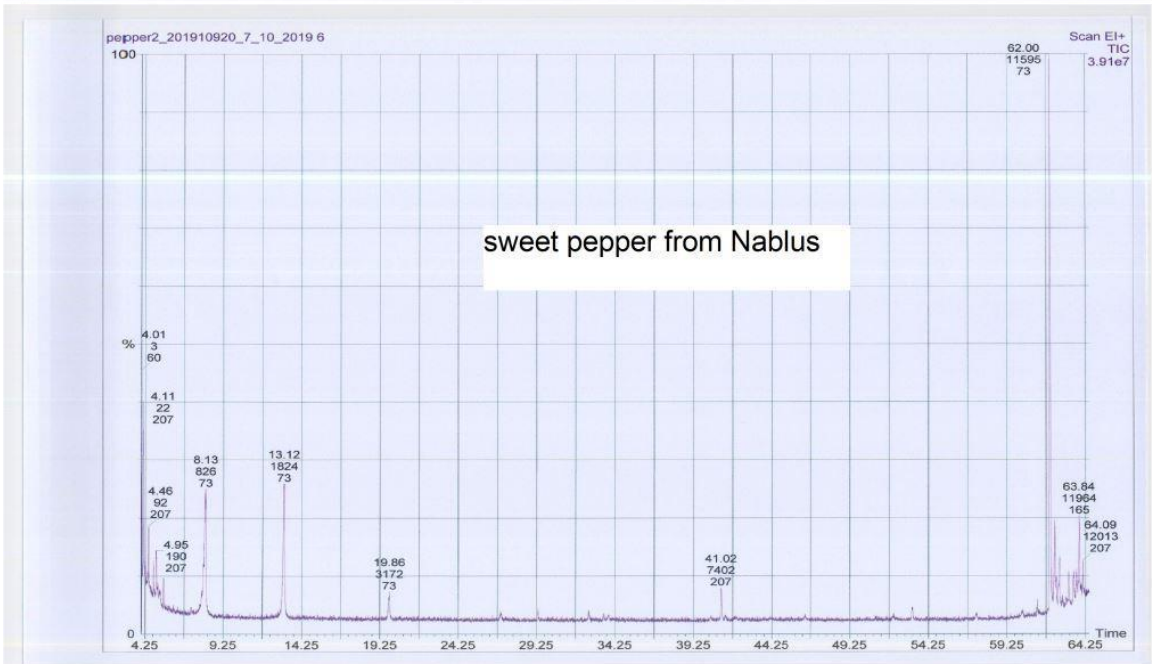
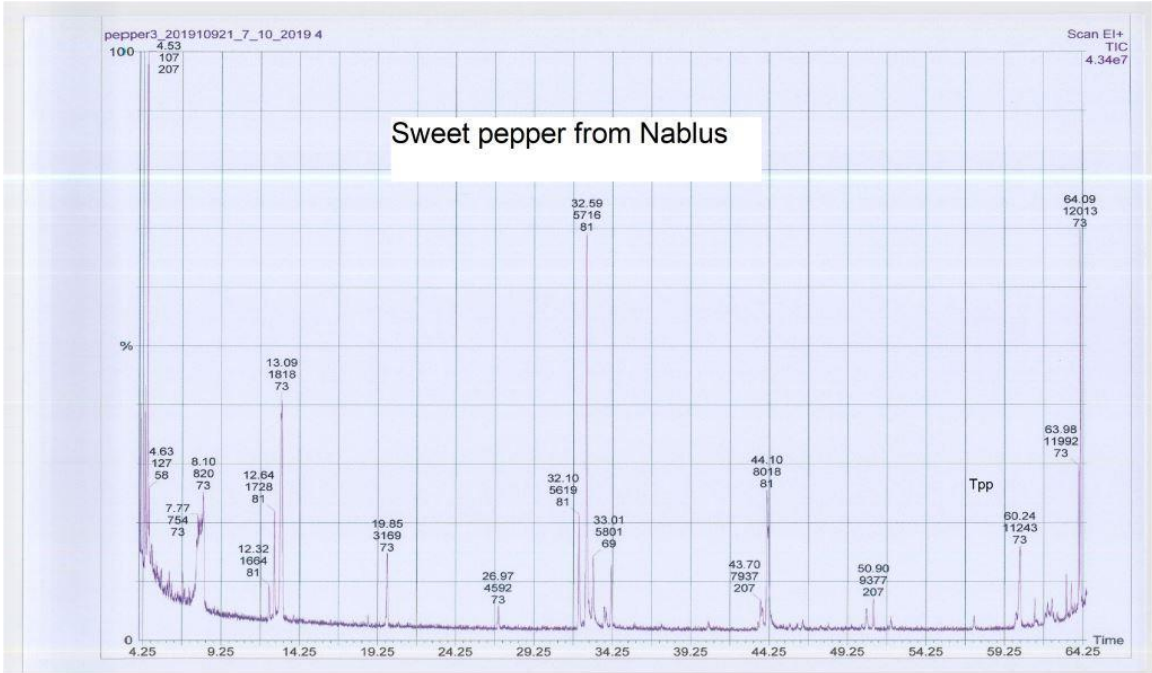


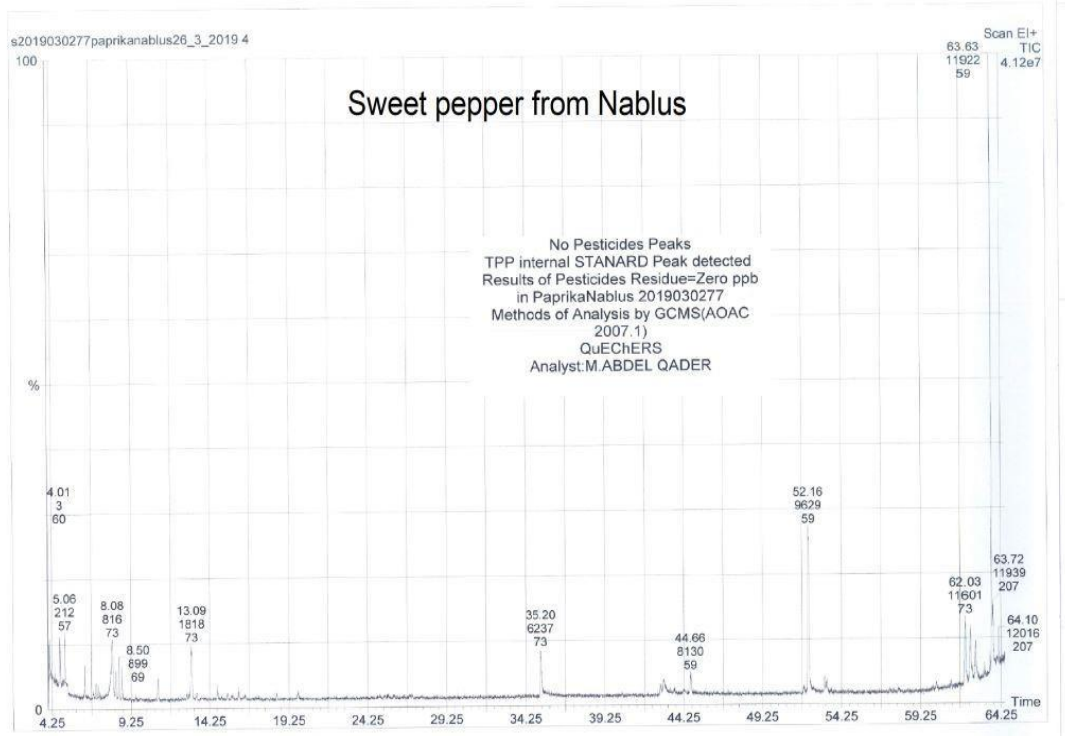




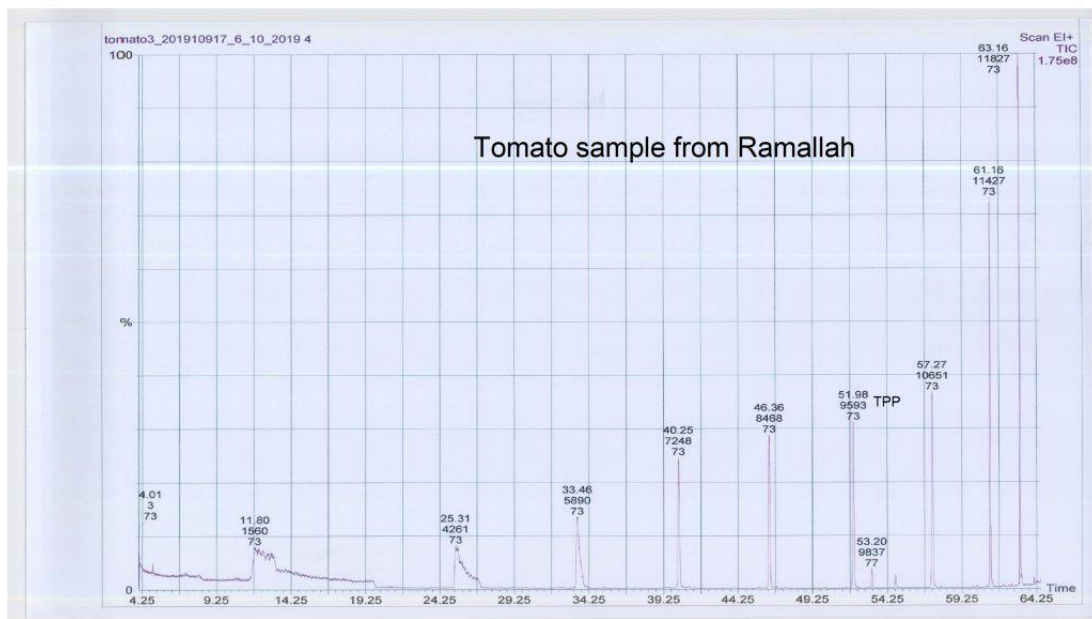
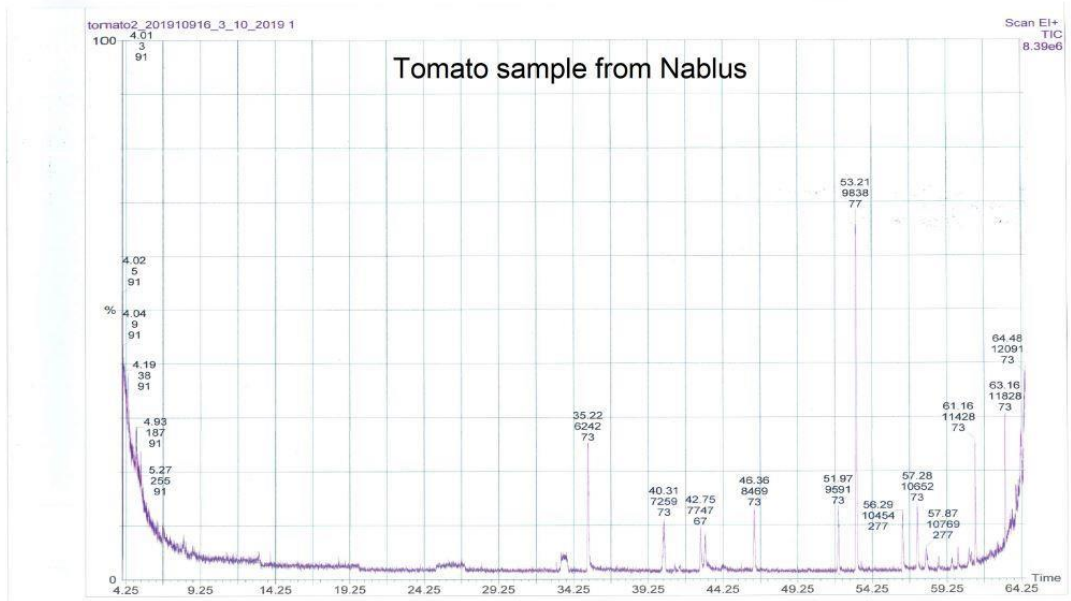


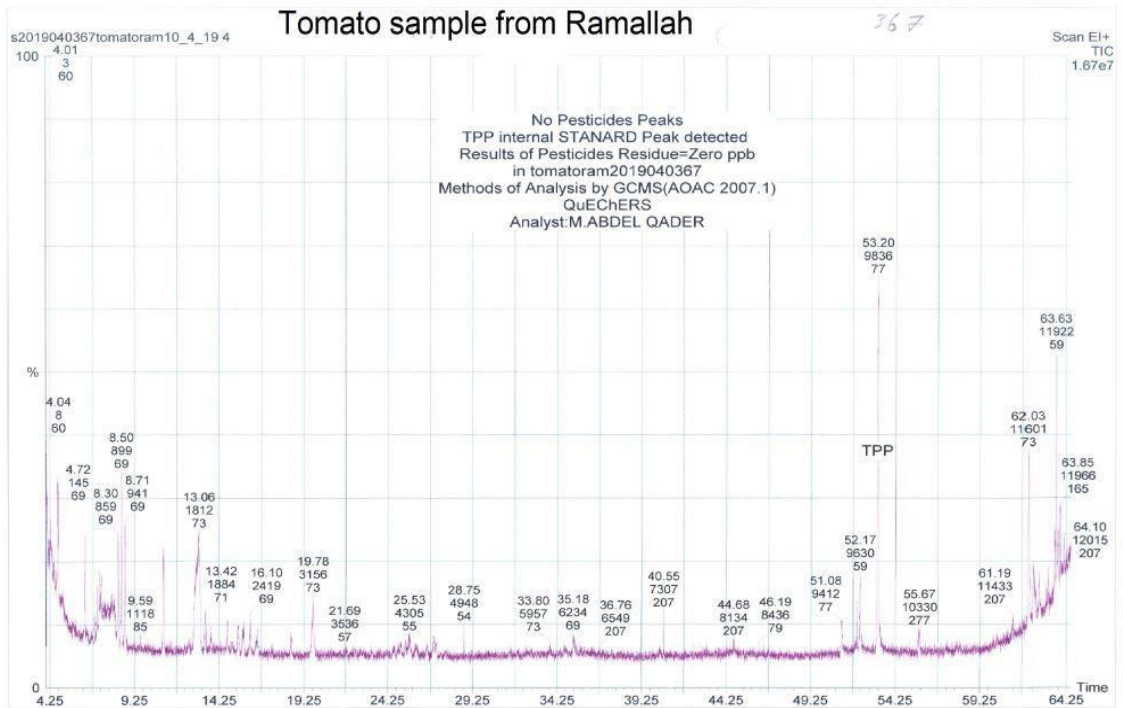
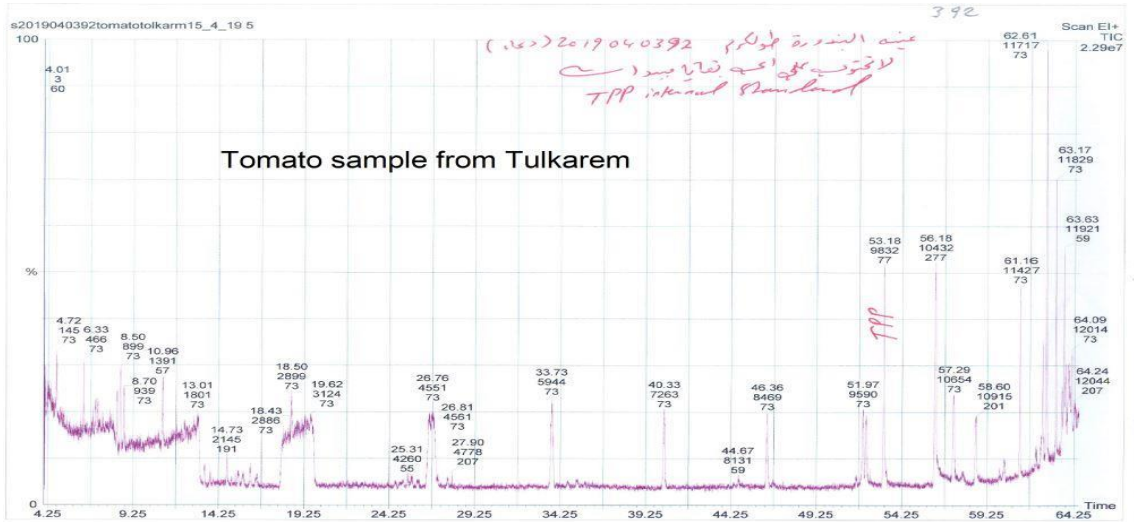


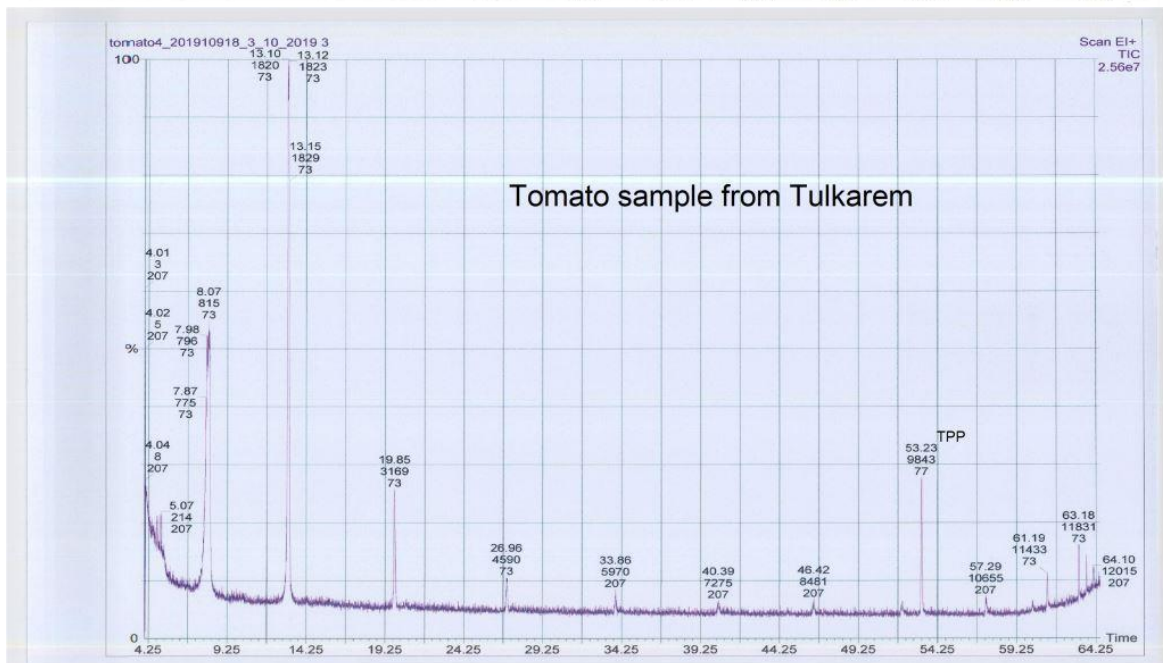
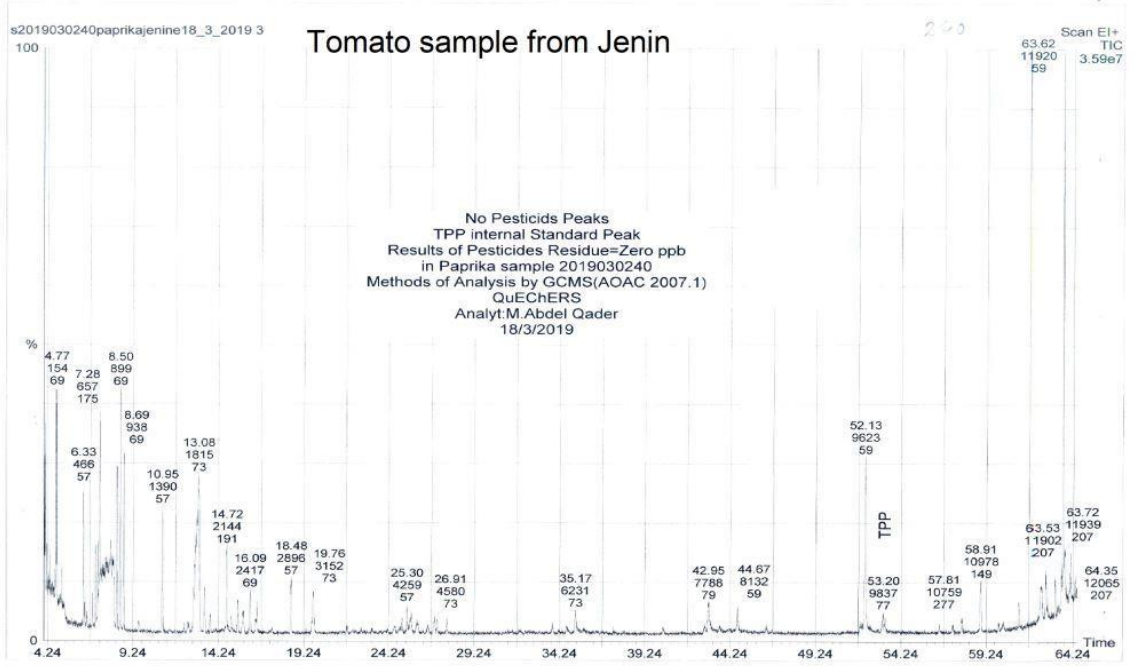


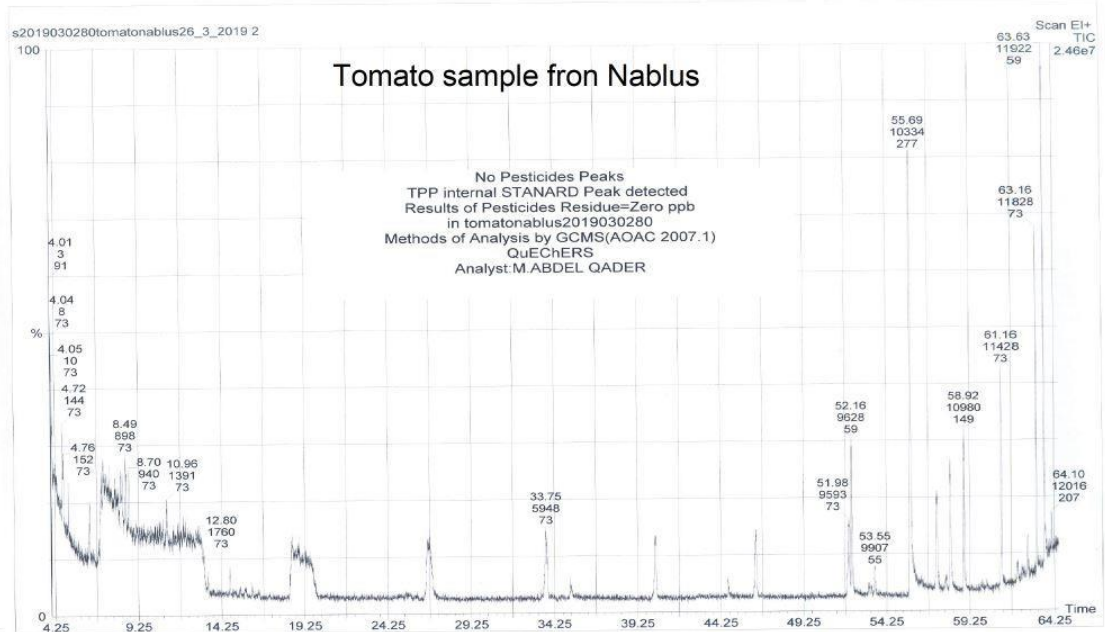
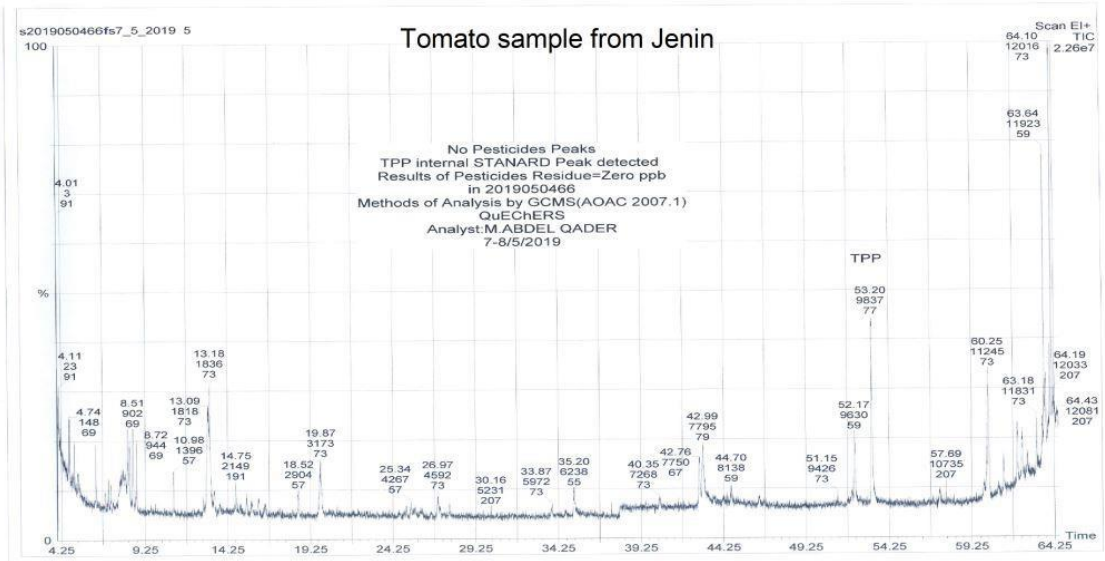


### 3. Imported tomato samples

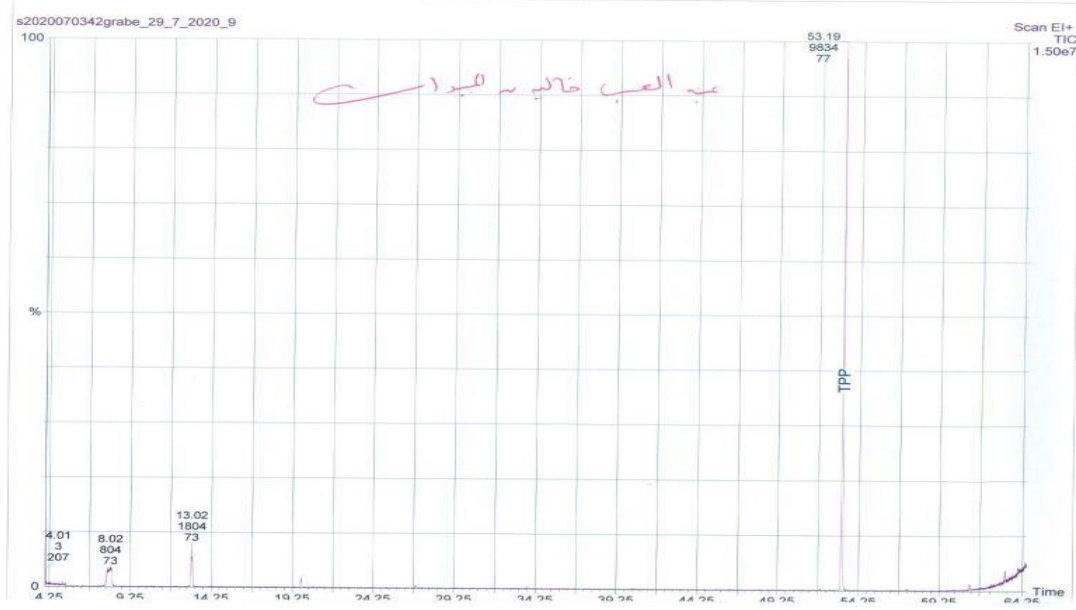
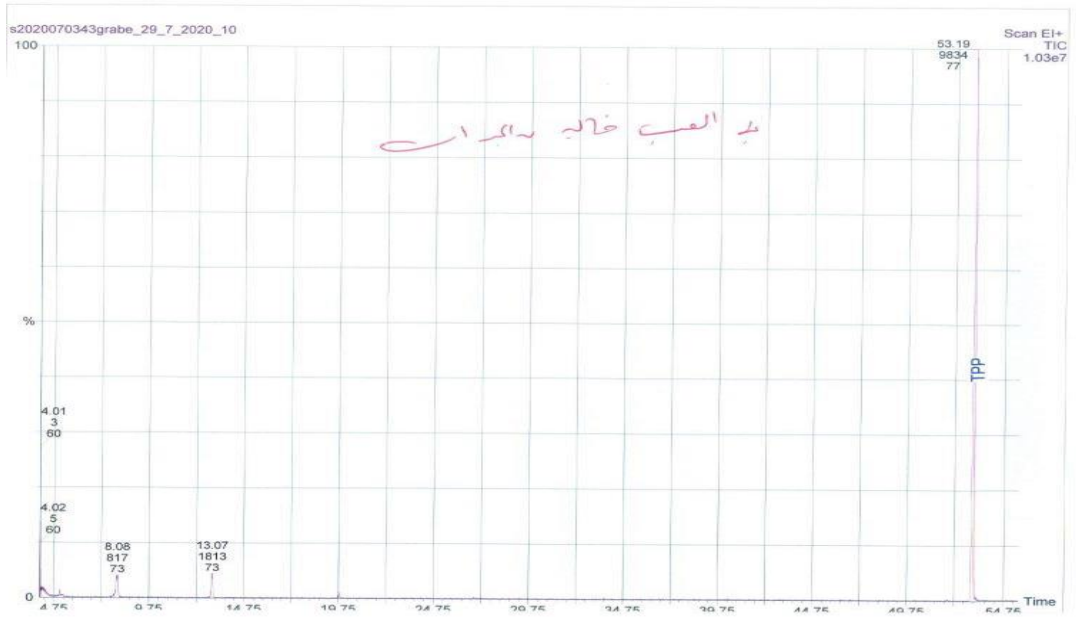


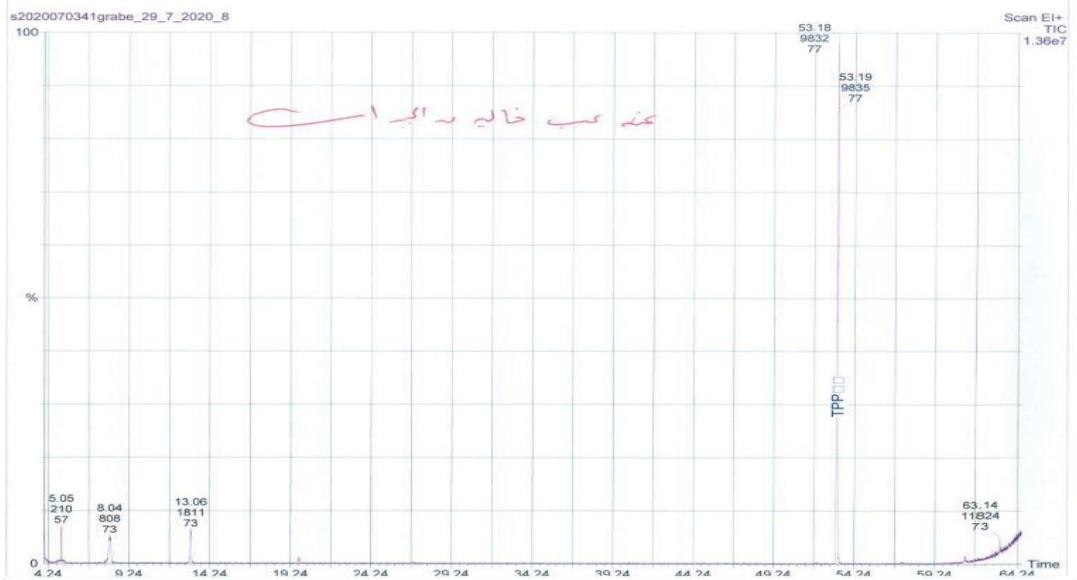


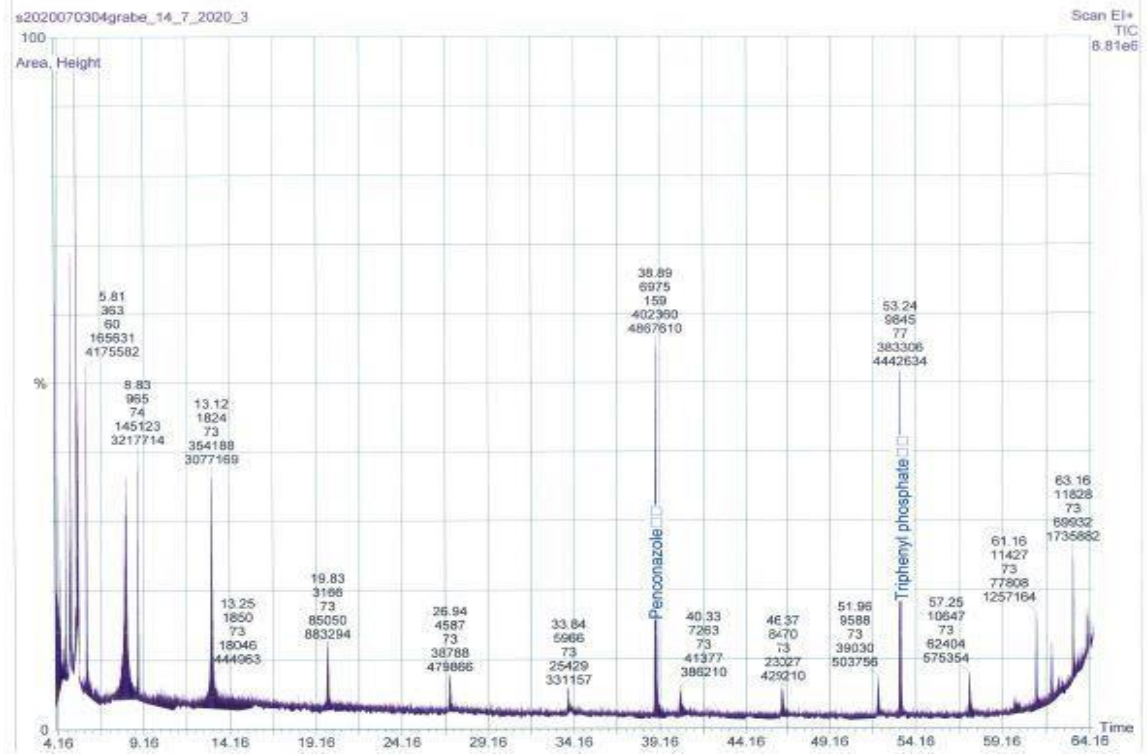
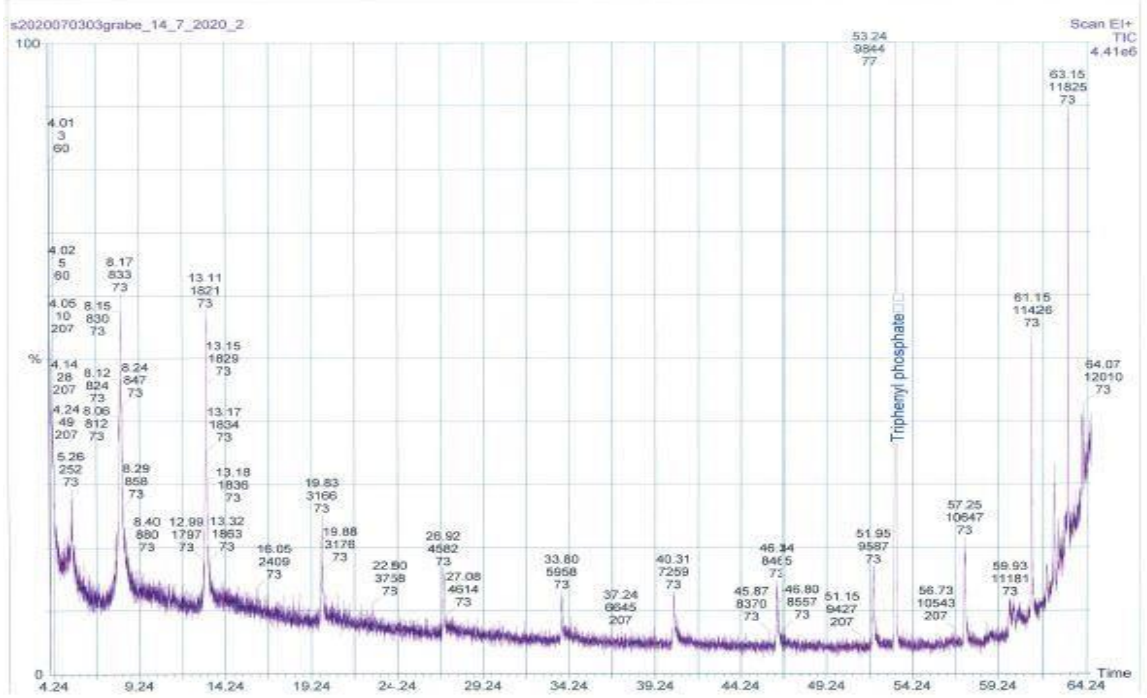


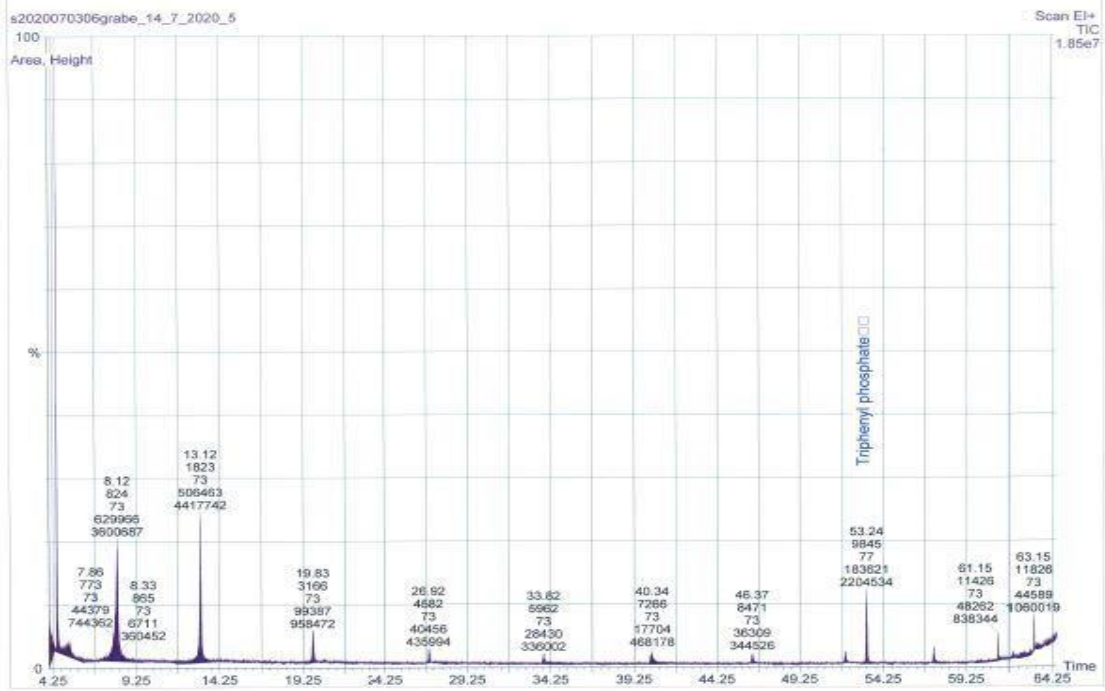
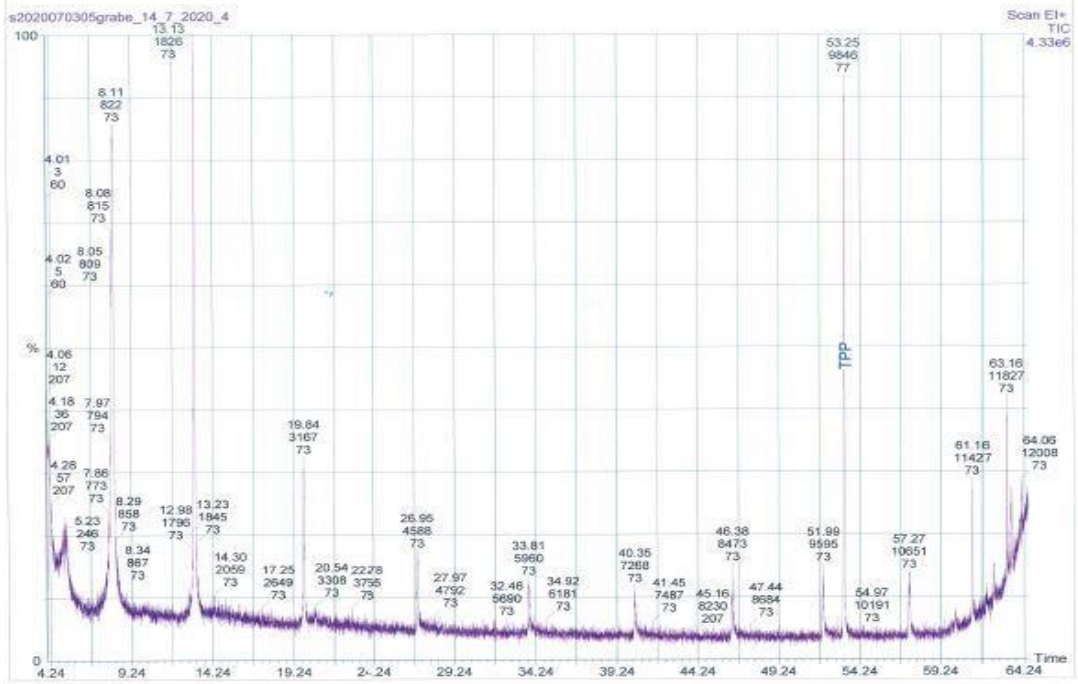


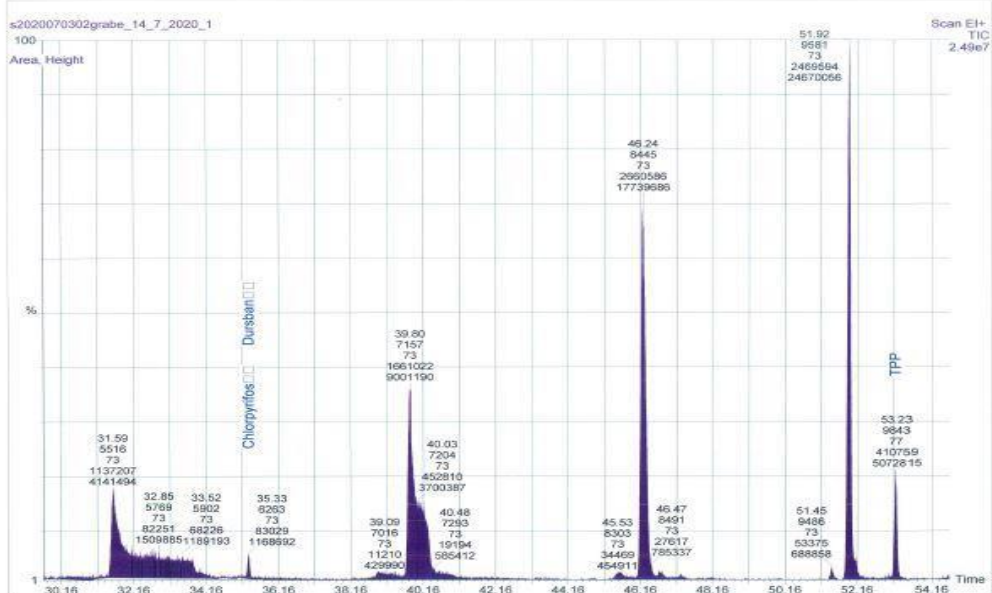
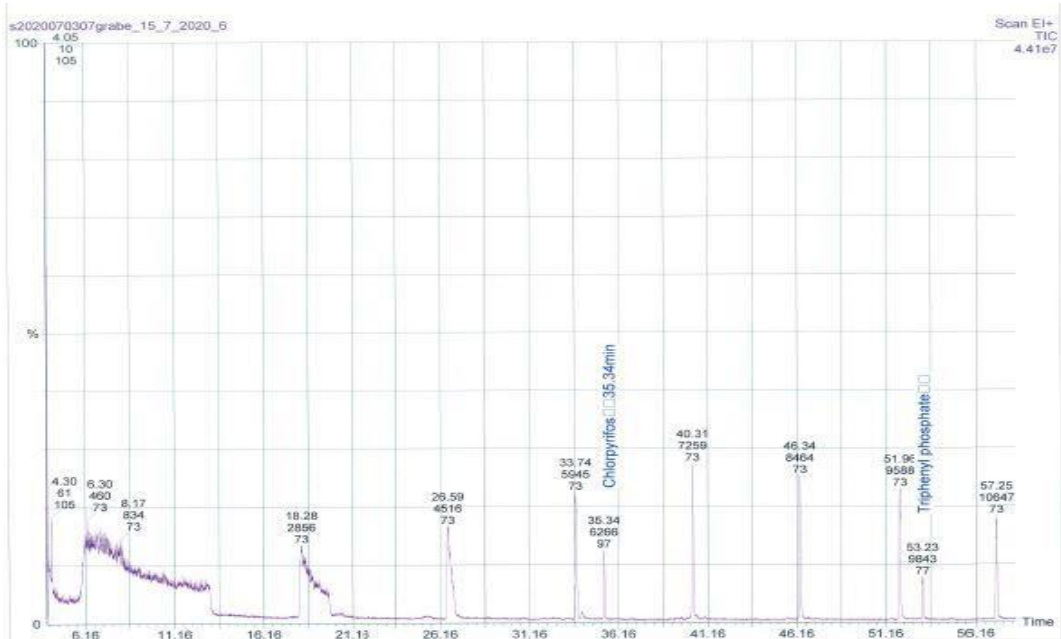
### 4. Results of local grape samples











جامعة النجاح الوطنية  
كلية الدراسات العليا

## المتبقيات السمية في محاصيل الفلفل الحلو، البندورة والعنب المستوردة في شمال الضفة الغربية

إعداد

دعاء أكرم يحيى

إشراف

د. عبد الفتاح حسن

د. عبد الله العمري

قدمت هذه الأطروحة إستكمالاً لمتطلبات الحصول على درجة الماجستير في العلوم البيئية، بكلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس - فلسطين.

2021

ب

المتبقيات السمية في محاصيل الفلفل الحلو، البندورة والعنب المستوردة في شمال الضفة الغربية

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الملخص

تعتبر بقايا المبيدات من الملوثات الخطرة التي تؤثر على جودة الثمار وتسبب خطراً على صحة الإنسان. في هذه الدراسة تم فحص بقايا المبيدات في 38 عينة من محاصيل العنب والبندورة والفلفل الحلو في شمال الضفة الغربية. بالإضافة إلى ذلك، تم اختبار عشر عينات من المنتجات المحلية.

تم تحضير العينات للفحص في مركز البحوث الزراعية التابع لوزارة الزراعة في مدينة جنين. تم الكشف عن بقايا المبيدات باستخدام جهاز GC-MS وفقاً للبروتوكول المعتمد في مختبرات جامعة النجاح الوطنية. كما تم إعداد استبيان حول المنتجات الزراعية الامنة في السوق المحلي.

أظهرت نتائج العينات المستوردة خلوها من بقايا المبيدات، أما بالنسبة للعينات المحلية فقد تم العثور على نوعين من متبقيات مبيدات الكلوريفوس والبينيكنازول في ثلاث عينات.

أظهرت نتائج تحليل الاستبيان أن حوالي 85% من المستهلكين لا يشعرون بالأمان عند تناول الفواكه والخضروات الموجودة في الأسواق المحلية، ويؤيد حوالي 92% من المستهلكين وجود الخضراوات والفواكه الامنة التي تتضمن شهادة تبين استخدام الممارسات الزراعية الجيدة في زراعتها. كما تبين ان 80% منهم المستهلكين يوافقون على دفع سعر أعلى مقابل الحصول على هذه المنتجات. كما وجد أن لدى النساء ثقة أكبر من الرجال في التزام المزارع بالممارسات الزراعية

ج

الجيدة, وتبين النتائج أيضا أن الفئات العمرية الكبيرة لديها معلومات أكثر عن المنتجات الزراعية الآمنة ووجود بقايا المبيدات الزراعية في الفواكه والخضروات.

بالإضافة إلى ذلك، أظهرت النتائج أن الفئات العمرية الأكبر لديها استعداد أكبر لدفع سعر أعلى للحصول على منتجات زراعية آمنة. كما لوحظ أن الأشخاص ذوي الدخل المرتفع كانوا أكثر استعدادًا لدفع سعر أعلى مقابل الحصول على منتج زراعي آمن.

