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OLIVE

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JORDAN

WHERE OLIVE TREES GREW
LONG BEFORE THE ADVENT OF CIVILISATION

OLIVAE

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EDITORIAL

WELCOME TO JORDAN, WHERE OLIVE TREES GREW LONG BEFORE THE ADVENT OF CIVILISATION

The oldest traces of this crop date back more than 5,400 years. Researchers studying olive tree DNA claim that many of the varieties sold worldwide may be descended from *Mehrez*, a local variety. The Romans were the first to cultivate the olive tree systematically, but the plant has its roots in the land of the river Jordan and is intertwined with Jordan's history and the culture and traditions of the three great monotheistic religions.

Of the 11 million olive trees in Jordan, almost 20% are from the Roman category; these trees are so old they are a witness to history.

Up to 20% of the agricultural land in Jordan is dedicated to olive trees. With over 80,000 businesses involved in olive growing, the olive sector is one of the most dynamic sectors in the Kingdom. The country was also the first in the Middle East to hold a national extra virgin olive oil competition following the rules of the IOC's Mario Solinas Quality Award.

Thanks to this enthusiasm, to avant-garde technology, and to the close relationship between its institutions, academia and young entrepreneurs, Jordan reached self-sufficiency in the early 2000s. Today, Jordanian olive products are exported all over the world and have become a point of reference for world demand. Jordan's olive industry is blossoming thanks to the synergy between its institutions, the public sector and private enterprises, which are represented by JOPEA, the Jordan Olive Products Exporters Association.

Many of the top positions in this association are held by women. Indeed, a few years ago, the country drew from Pandolea International's initiative and set up the Jordanian Women's Olive Oil Network and became the founder of the Arab Olive Oil Women's Association. This network strives to promote the conscious consumption of Jordanian extra virgin olive oil, especially among young consumers.

Congratulations to the editorial board for their hard work and congratulations to the 2022 chair of the International Olive Council, the Minister of Agriculture Eng. Khaled Al-Hanaifat, for his support. The Minister's preface can be found on the next page.

We hope you like this issue. Enjoy your trip to Jordan.

Mr. Abdellatif Ghedira
Executive Director of the IOC

PREFACE

Jordan is regarded globally as a producer of high-quality foods thanks to the quality of its products, production methods and safety of the global food basket throughout the year. Jordan's recent history is rich in agricultural industrial exports, and the olive sector is considered one of the most important agricultural industries in the Jordanian food sector. It's worth mentioning that the olive industry in Jordan has made significant progress in the domestic and foreign markets, as food products manufactured from olive fruits are highly appreciated by importing countries around the world.

The main strength of the olive industry is the high quality of Jordanian olive oil. This has allowed stakeholders in this sector to gain global recognition. The production chain of Jordanian olive oil is integrated, and applies high-level international quality standards at the production and industrial levels, as well as advanced technology.

Jordan is considered one of the first countries to promote scientific research projects and keep pace with all developments in the olive sector, which are implemented by many governmental and private institutions that adopt common and multiple approaches in all disciplines.

The governmental measures led by the Ministry of Agriculture support the development of the olive and olive oil sector, as the olive sector includes a number of official institutions such as the National Agricultural Research Center, the Royal Scientific Society, the Jordan Standards and Metrology, Jordan Food and Drug Administration, and Jordanian universities. The faculties of Agricultural Engineering, Chemistry, Medicine and Pharmacy are particularly involved and all these bodies also work closely on scientific research in the fields of sensory and chemical analysis.

The Jordanian olive sector has a pioneering and distinctive feature that must be highlighted, which is the close link and permanent coordination between the public and the private sectors. This private sector is represented by olive oil mills and producer's trade unions, the Jordan Olive Products Exporters Association, the Jordanian Society for Sensory Evaluation of Food.

Furthermore, we haven't lost sight of the role of women, as Jordanian women through The Women's Olive Oil Association have played a prominent role in spreading olive oil culture, by encouraging the local consumer to increase consumption of olives and olive oil.

In addition, the olive sector has been able to develop many relationships with other agricultural sectors, especially animal farming and forestry, and other activities such as olive oil tourism. This has resulted in an interesting diversification and it has also given rise to opportunities which made it possible to make this interaction widely visible to all sectors.

Finally, Jordan's participation in the International Olive Council since 2002 is a testament to the importance of development in this sector. This partnership, in line with most international standards, is aimed at improving the quality of all olive products, including table olives and olive oil.

Eng. Khaled Al-Hnaifat
Minister of Agriculture

THE HISTORY OF THE JORDANIAN OLIVE TREE AND JORDAN'S TREASURES

Eng. Neder Masadah

Eng. Nehaya Al-Muhesin

Eng. Hureya Al-Faori

Olive trees have been growing in Jordan for approximately 5,400 years. Jordan is considered one of the oldest olive cultivation sites in the world, and historical perennial olive trees can be found in different parts of the country. In Jordan, 15%-20% of all land is planted with olive trees. Wherever you look, you will find olive trees standing tall in all their splendour before you.

The longevity of olive trees in Jordan through the ages is proof of their ancient history as a result of the fertility of the land. Undoubtedly, it is one of the few trees that humans learned to plant before they even were able to write. In this sacred place, the olive trees bear fruit, and are considered an infinite resource.

Jordanian farmers colloquially call a three-year-old tree a "gharsa" (which means "transplant"), and a three- to ten-year-old tree a "shaqiha" (name of the tree). Once the tree has been fixed in the ground for ten years it is called a "shajara" (which means "tree").

Olive growing was introduced by the Romans. They spread the art of cultivating olive trees in different regions and they maintained the cultivation of this type of indigenous perennial olive trees over time. The Romi type of olive tree has been widely planted and is the most common perennial olive tree in Jordan.

The results of radioactive carbon dating performed on olive stones from the Jordanian Kharijites heights region have scientifically proved that the history of olive cultivation goes back to the last two centuries of 5000 BC. This period also witnessed the emergence of olive cultivation in the area of Teleilat Ghassul in the Dead Sea. Many reports have shown that agriculture has had a very long history in the Wadi Rum region of Jordan, with traces of olive cultivation dating back to the Bronze Age (3000 BC) at the site of Hadib al-Rih in Wadi Rum.

Yet, perennial olive trees still grow in different regions of Jordan, attesting to the long history of this variety of olive trees in the country. Currently some trees have significant historical value and have been classified as ancient trees. Many of them still bear fruit and their products are used in traditional Jordanian dishes. Unfortunately, the existence of these old trees is jeopardised by a number of factors, such as the gradual transformation of traditional olive groves into new commercial orchards.

These ancient trees are being removed from the more fertile soil and being replaced with more profitable crops. Furthermore, huge olive trees are currently being traded as ornamental trees for business.

Many local community institutions have begun to protect these sacred trees in cooperation with the Jordanian Ministry of Agriculture, and stakeholders have launched an initiative called "Grandparents' olives", viewing this crop as a treasure for the coming generation. These "grandmother trees" are given names that link their historical heritage to tourist attractions and agricultural landmarks. The goal is for these plants to be passed on from generation to generation.

Ten trees were named in the various Governorates of the Kingdom as follows:

1. Grandma Zaytouna Ain Sirin (Tebneh town - Irbid Governorate).
2. Grandma Zaytouna Arar (Jedita town - Irbid governorate).
3. Grandmother Zaytouna Khaled bin Al-Waleed (Aqraba town - Irbid Governorate).
4. Grandma Zaytouna Al-Noor (Umm Joza town - Al-Balqa Governorate).
5. Grandma Zaytouna, Fajer of Palestine (Sawada town - Balqa governorate).
6. Grandmother Zaytouna Afra (Afra town - Irbid Governorate).
7. Grandma Al-Zaytouna Aima (Aima town - Tafila governorate).
8. Grandma Al-Zaytouna Al-Maysir (Al-Hashmiyah town - Ajloun governorate).
9. Grandma Zaytouna Famia (Jerash Governorate).
10. Grandma Zaytouna Rum (Wadi Rum - Aqaba Governorate).

The main objectives are:

- To certify all perennial olive trees and determine their geographical locations.
- To check the quality of the product from these trees (olive fruit and olive oil).
- To create a genetic fingerprint of these trees using genetic coding.
- To label all perennial olive trees on a world tourist map.
- To create sustainable job opportunities and sources of income for the owners of these trees through tourism and agricultural projects.
- To upskill women from rural areas so as to begin new projects that will open new horizons for them through sustainable development.
- To preserve the heritage of the olive tree and its religious, social and cultural connotations for future generations.

OLIVE SECTOR IN JORDAN

Eng. Ussama Kattan

Eng. Barehan Bakri

Eng. Jawaher Al-Habahbeh

Eng. Layith Al-Qudah

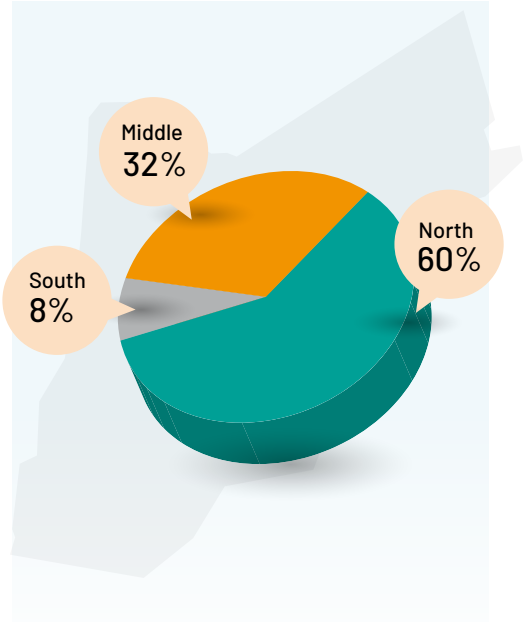
In Jordan, the olive tree is regarded as one of the most important crops. Throughout the ages it has been a symbol of peace, love, and strength, blessed by all the monotheistic religions.

Jordan is one of the natural places for olive cultivation in the Middle East, and evidence of this is the presence of perennial olive trees, the so-called "Roman trees", in reference to their antiquity. They are spread across different areas and constitute 20% of the area planted with olives.

Olive cultivation is widespread throughout the Hashemite Kingdom of Jordan, in its mountains, plain and desert areas, and is distributed over the three regions of the Kingdom (60% in the Northern region, 32% in the Central region and 8% in the Southern region. (Figure 1.)

Rainfed olive cultivation constitutes 62% of olive cultivation. Olive cultivation is a basic social and economic pillar for many Jordanians, and it represents a source of income for more than 80,000 families, generating domestic income estimated at 120 million Jordanian dinars annually. The volume of investments in this sector exceeds one billion Jordanian dinars.

Figure 1. Distribution of olive cultivation over regions of the kingdom



The cultivation of olives in Jordan has developed remarkably, as the area planted with olives increased to reach 570,000 dunums, and the number of planted trees reached about 11 million trees, equivalent to 72% of the area planted with fruit trees and 20% of the total cultivated area.

The production of olive fruits from 1995-2020 developed significantly, with production increasing from 63,000 tons in 1995 to 215,000 tons in 2019, (Figure 2). The production rate of olive fruits between 2011-2020 is estimated to be about 154,000 tons, 22% of which are used as table olives and 78% as olive oil. The production rate of olive oil during the same period was about 23,400 tons (Figure 2). The fluctuation in production is attributed to several factors, most notably climatic conditions and the alternate bearing phenomenon that is common in olive cultivation. It should be noted that since 2000, Jordan has achieved self-sufficiency in olive oil and has begun a new stage of development by exporting olive oil to many countries of the world. The most important of these are the Arab Gulf countries and the USA.

Average olive oil exports between 2011-2020 were 1,100 tons.
As for the olive mills sector, there were 137 licensed mills in 2020/2021, 15 mills operating the two-phase system, 118 mills using the three-phase system, and 4 using hydraulic presses. The total number of production lines for these mills is 304, with a total production capacity of 391,4 tons/hour (Table 1). There are more than 70 production lines for filtering and packaging olive oil, 30 in olive mills, and the rest in packing companies.

Figure 2.

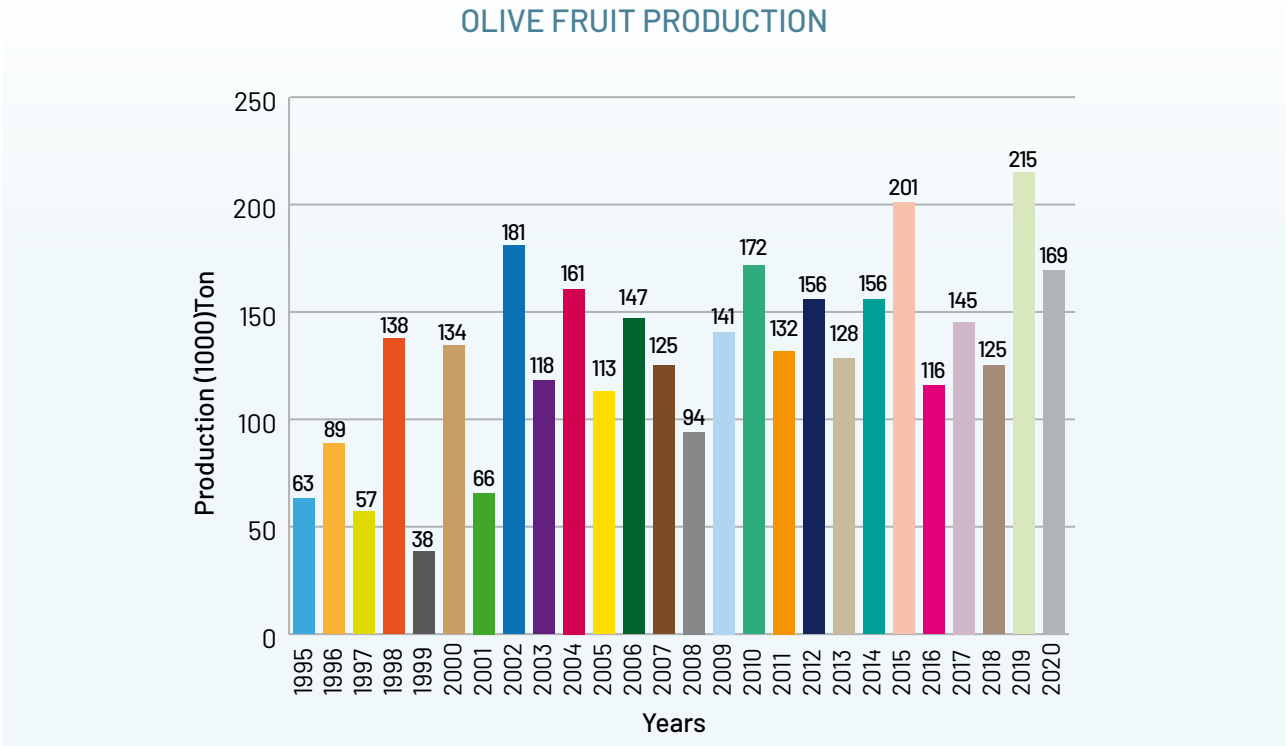
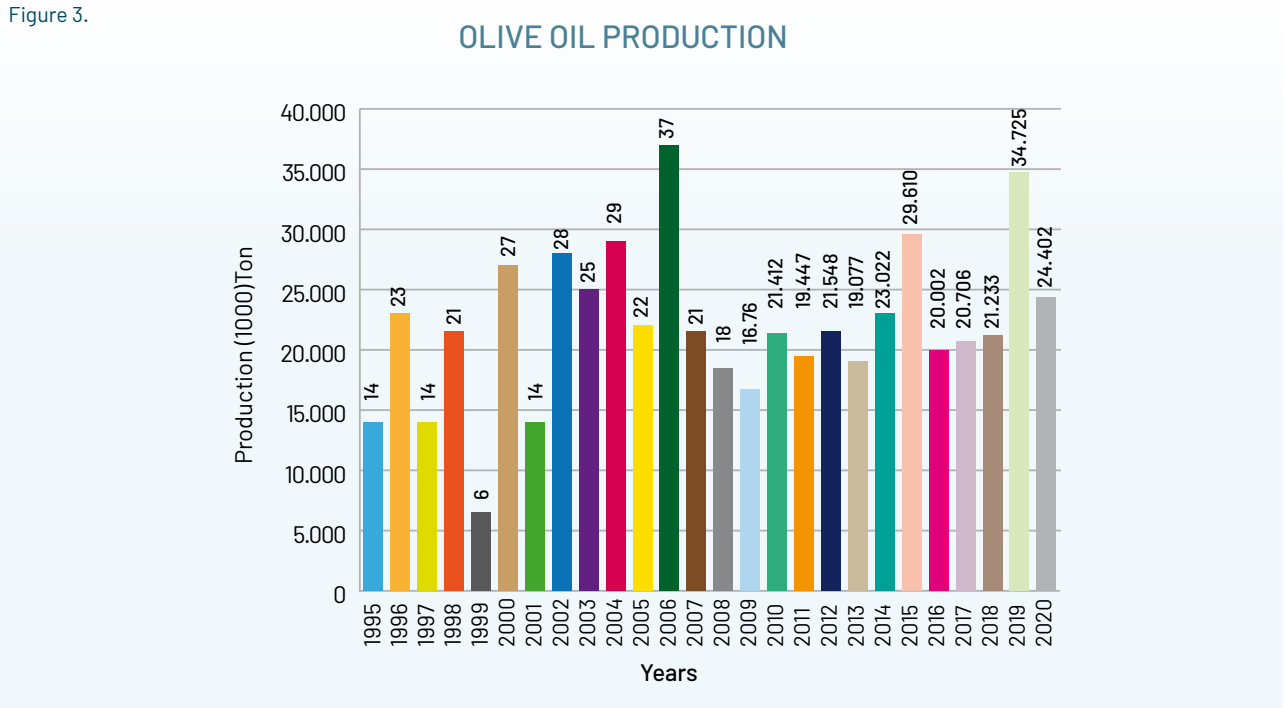


Figure 3.



The production rate of solid waste (pomace) during 2015-2020 was about 43,000 tons annually. After drying and pressing, pomace is used as a substitute for fuel in the operation of mills and as domestic fuel for heating. The annual production rate of liquid waste (zebar) during the same period was about 162,000 m^3.

The annual average quantity of olive fruits allocated for table olives between 2011 and 2020 stood at about 28.000 tons.

Table 1.

Type of olive mill	Season 2005/2006	Season 2010/2011	Season 2020/2021
Hydraulic presses	11	8	4
Three outlets	74	86	118
Two outlets	19	24	15
Total	104	118	137

There are 20 factories for the production of table olives, all of which produce according to the international standards issued by the International Olive Council. Jordan exports all kinds of processed table olives (stuffed olives, chopped, pickled, etc.) to more than 48 countries worldwide, the most important of which are the United States of America and the Arab Gulf countries. The average export of processed table olives between 2011 and 2020 was 242,000 tons.

In view of the increasing importance of the olive sector in the national economy and as a result of the steady expansion in area and production, the government, represented by the Ministry of Agriculture, has taken several measures to develop the olive sector:

1. Establishing an olive directorate that undertakes the task of communication and coordination with all official and private agencies dealing with the olive tree and olive oil in cultivation, manufacturing and trade, in addition to coordinating with international institutions operating in Jordan to benefit from their capabilities in serving this sector. This directorate has developed and organised the strategic policies that support this sector, and through its efforts it seeks to provide the most appropriate means for olive growers and all the parties working in this sector in a way that meets their priority needs.
2. In order to put Jordan on the map of the world's olive oil producing and exporting countries, the Jordanian government joined the International Olive Council (IOC) at the end of 2002, to benefit from global experience

in solving oil marketing problems by taking advantage of focused promotional campaigns implemented by the IOC and directed at societies with promising markets. Jordan's membership of the council has also helped to improve the quality of Jordanian olive oil and establish panels for the sensory evaluation of olives and olive oil.

3. The Ministry of Agriculture, through the National Centre for Agricultural Research, established an olive research department, which is responsible for conducting studies and scientific research in the field of olive and olive oil technology to keep pace with all global developments, and boasts an infrastructure that includes research stations, laboratories, devices and necessary equipment, in addition to a field gene bank of olive cultivars.
4. Distributing at least 150,000 olive seedlings annually produced in 3 stations and nurseries affiliated with the Ministry of Agriculture with authentic, healthy and pest-free varieties sold at subsidised prices. This is in addition to the production of 200,000 olive seedlings by the 123 private nurseries licensed by the Ministry.
5. Supporting and implementing extension programmes, workshops and specialised training courses in the olive sector, and providing free extension services to olive growers. This has contributed to achieving agricultural and rural development, educating farmers and developing their capabilities and skills.
6. Granting soft loans to farmers and investors through the Agricultural Credit Corporation to encourage olive cultivation and industries based on the olive sector.
7. Implementation of a national campaign to market olive oil every year in cooperation with Jordanian olive oil mills and producer's trade unions and the General Union of Farmers, which aims to provide all workers in ministries, institutions and government departments with high quality olive oil at reasonable prices.
8. Holding the National Olive Festival and Rural Women's Products Exhibition annually. This has contributed to helping small farmers market their products and provide consumers with high quality olive oil and table olives at attractive prices.

Thirteen local varieties are cultivated all over the Kingdom (Figure 4), in addition to many foreign varieties (Table 2), with the local varieties being considered the most suitable, resistant to local climatic conditions and of high quality.

Figure 4. Jordan Governorates

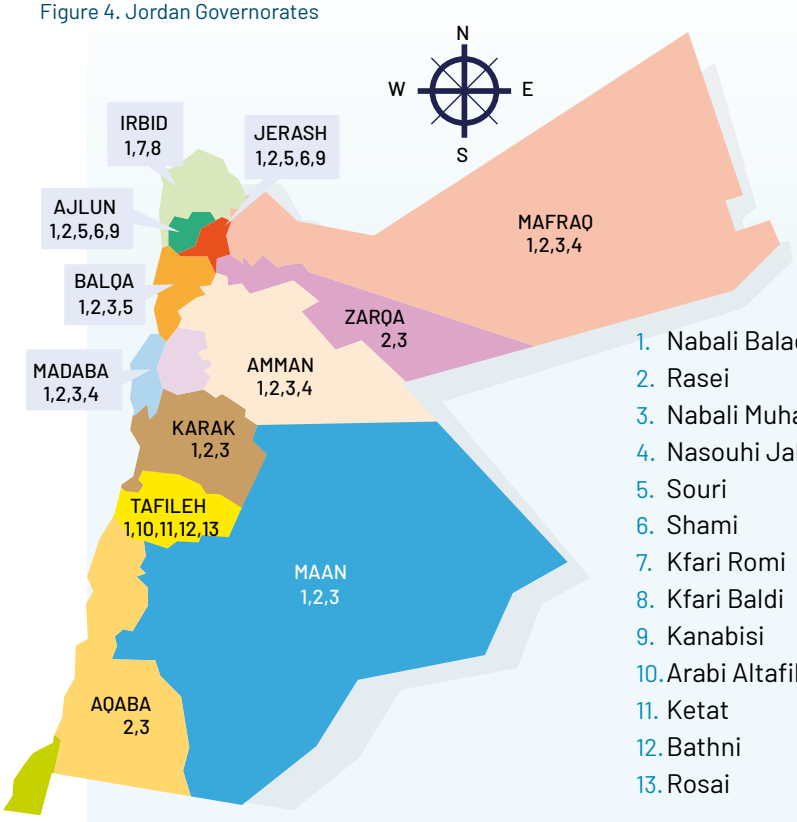


Table 2.

FOREIGN VARIETIES	
1	Coratina
2	Frantoio
3	Ascolano
4	Manzanillo
5	Baroni
6	Turkey Shaker
7	Gross di spanga
8	K18
9	Koroneiki
10	Hojiblanka
11	Morisca
12	Picual
13	Arbequina
14	Chemleli

PHYLOGENETIC ANALYSIS REVEALS JORDAN WAS ONE OF THE CENTRES OF ORIGIN FOR OLIVE TREE CULTIVATION THROUGHOUT THE AGES


Dr. Nizar Haddad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Dr. Wisam Obeidat

The oil-producing olive cultivar Mehras from Jordan is a historical cultivar, with actively producing fruit trees reaching some 1000-year lifespans. The historical olive cultivar Mehras, from the Maysar area in the Alhashemya town of Ajloun, is considered one of the oldest genetic olive genotypes in the Mediterranean region. The reason for choosing the name Mehras instead of Romi is that the cultural heritage, especially in Ajloun, distinguishes between the size of olive trees.

This research is part of a national plan led by the National Agricultural Research Centre (NARC) in partnership with many researchers in Jordanian universities to document the genetic maps of several species and breeds of crops and animals with agricultural importance.

Several chloroplast genomes were identified and investigated from Olea species which have adapted to different habitats. In this study, we assembled the complete chloroplast genome in Mehras using next-generation sequencing. Mehras leaves were collected from Alhashemya, Ajloun and Jordan (32.365906N, 35.663445E). DNA was extracted using the total genome wizard kit (Promega, Madison, WI).

The phylogenetic analysis showed that Mehras was genetically the closest to be a source of origin for the cultivated olives in Spain, Italy, and Cyprus and was included in the same genetic group (Figure 1). The results of the nucleotide sequence of the 'Mehras' genome showed that it has a unique genetic diversity at a molecular level. According to the study, significant mutations exceeding 15 million SNPs affected olive trees; nearly half a million are evident in the genetic coding regions with great influence by altering amino acids.

The results of studies carried out by the NARC proved that a high percentage of oil can be extracted from Mehras olives - up to 28%, one of the highest percentages among olive varieties in the world. Mehras oil also boasts a distinctive fatty acid composition, with one of the highest percentages of oleic acid - up to 70% - compared with other varieties, in addition to the sensory properties and its distinctive fruity flavour. There is also a strong linkage between the study outputs and archaeological discoveries which proved that the oldest human settlement ever known to contain olive trees was in the Jordanian village of 'Hadib Al Reeh' in Wadi Rum, which dates back to 5400 BC.

Mehras is a genuine ancestor variety and it has survived through the ages. Its genetic fingerprint has proven its rich and unique genetic diversity among available olive genotypes around the Mediterranean basin.

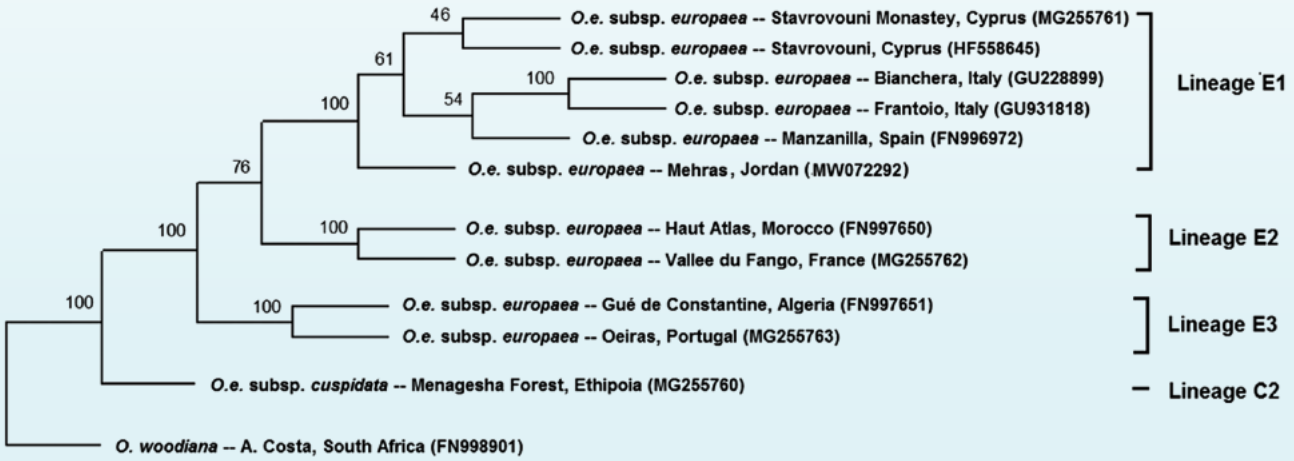


Figure 1. Plastid DNA maximum-likelihood phylogenetic tree of Olea europaea subsp. europaea cultivar Mehras along with other isolates. Bootstrap values are given on each branch (1000 replicates). O. e. subsp. cuspidata and O. woodiana were used as out-groups. Olive plastid lineages were based on Besnard et al. (2011).

Its genetic features have significant implications on the ability of Mehras to adapt to climate change and harsh environments while maintaining a distinctive olive oil quality.

Further information is available on this link

CURRENT SITUATION OF THE SENSORY EVALUATION OF VIRGIN OLIVE OIL IN JORDAN

Eng. Jamal Al-Batsh

The royal directives of His Majesty King Abdullah II related to the need to promote the olive sector in Jordan, and to meet the requirements of Jordan's accession to the International Olive Council (IOC). This accession obliges member states to adopt the IOC's international standards, including the sensory evaluation of olive oil, which is one of the most important indicators for determining the quality of virgin olive oils. This standard has been adopted and is being evaluated accordingly.

The main purpose of quality assessment is to ensure that consumers obtain high-quality olive oils, and that the description on the label matches the oil in the package. Therefore, in October 2003, the Ministry of Agriculture (MOA), in cooperation with the European Industrial Development Program (EJADA), formed two sensory assessment panels in line with international standards, and under the supervision of the international expert Paola Virovanti, the two panels have been approved annually by IOC.

To enable sensory evaluation panels to perform their tasks correctly, the Jordan Standards and Metrology Organization, with the support of the Economic and Social Productivity Enhancement Program, established and equipped a sensory evaluation laboratory for olive oil in accordance with IOC specification no. COI/T02/Doc.6.

To fulfill the requirements of the requesting parties for certificates of conformity for Jordanian olive oil, the Corporation was keen to qualify this laboratory to obtain international accreditation from the German Accreditation Authority in January 2008 in accordance with the international standard ISO 17025.

In view of what the olive sector witnessed during the last two decades, with increases in cultivation area, productivity and product quality, and to enable Jordanian oil to compete in global markets in terms of quality, the MOA, in cooperation with the IOC during the years 2006-2008, implemented three 'Sensory evaluation of olive oil' training courses in accordance with the relevant international specifications and under the supervision of international experts from the IOC. The result of this was the creation of two other sensory assessment panels, both of which are subject to annual approval from the IOC.

In 2019, the MOA implemented another training course in accordance with international standards and under the supervision of Jordanian experts, which resulted in the establishment of another sensory evaluation panel, which has been approved annually by IOC.

In addition, in December 2012 the MOA established two panels for the sensory evaluation of table olives, through the training course it held in accordance with the international standard issued in this regard and under the supervision of Jordanian experts who were trained for this purpose in Spain in June 2012.

The MOA is aware of the prominent role that women play in the family and in the dissemination of the culture of using extra virgin olive oil and highlighting its health benefits to the younger generations. In 2021-2022 the Jordanian Women's Network for Olive Oil, in cooperation with the MOA and the IOC, organised two training courses in the field of sensory evaluation of olive oil according to international standards and under the supervision of Jordanian experts, which resulted in the establishment of two panels approved by the MOA in February 2022. With this achievement, Jordan now counts some seven sensory evaluation panels.

Due to the importance of the sensory evaluation of olive oil, as an essential and complementary component of laboratory tests, many associations interested in sensory evaluation were established in Jordan:

	NAME OF ASSOCIATION	ESTABLISHED YEAR
1	The Jordanian Society for Sensory Evaluation of Food	2010
2	The Jordanian Association of Producers and Exporters of Olive Products (JOPEA)	2004
3	Women's Olive Oil Association	2021

Since the establishment of the panels for the sensory evaluation of olive oil, they have contributed to improving the quality of Jordanian olive oil and enhancing consumer confidence in it, in addition to expanding its export opportunities in global markets

due to sensory characteristics that distinguish it in terms of taste, smell and distinctive chemical properties. It is worth noting that the most important activities carried out by these panels include:

1. Several workshops, courses and seminars in the field of sensory evaluation of olive oil with the aim of building the capacities of farmers, olive mill owners, school students, and various groups of society.

2. Active participation in the National Olive Festival and Rural Women's Products Exhibition, organised annually by the National Agricultural Research Centre in cooperation with the MOA and many local and international partners between 1999 and 2021, to enable festival-goers and consumers to purchase high-quality olive oil.

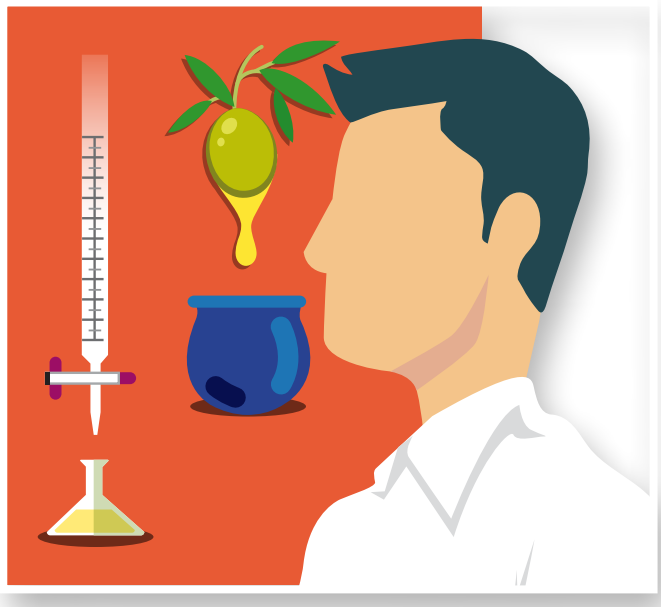
3. Participation in the project implemented by the University of Jordan between 2013 and 2016: the "capacity building project for workers in the Jordanian olive industry", which was supported by the European Union within the Tempus projects with the aim of improving the quality of Jordanian olives, and with the participation of five Jordanian universities and institutions as well as four European universities. As a result of the project, several workshops and seminars were held in the field of sensory evaluation of olive oil and two laboratories were established, the first for sensory evaluation of food, and the other for chemical tests, fitted with the latest equipment.

4. Active participation in judging the national competition for the best extra virgin olive oil for the 2020/2021 season, considered the first of its kind in Jordan and only the second in the Arab world to adopt Mario Solinas Quality Award standards. This competition was organised by Al-Balqa Applied University under the auspices of the IOC. The awards and medals were distributed to the winners and shields to the jury under the patronage of HRH Princess Basma Bint Ali and in the presence of the Executive Director of IOC, through a recorded speech.

5. The active participation of some panel leaders as arbitrators in the Mario Solinas Quality Award competition, which gave them the technical and practical skills necessary to organise such competitions in Jordan.

Many studies have confirmed that Jordanian olive oil has excellent advantages and characteristics in terms of taste and smell, and is very suitable for the various preferences of consumers in global markets. In order to export it to global markets, a distinct quality of extra virgin olive oil must be produced in order to maintain the identity of this product in the eyes of the consumer. Although such outstanding quality was attained, it became imperative to continue to apply international standards and issue the necessary certificates that reflect the distinguished quality of the product. It also became necessary to establish laboratories for the sensory evaluation of olive oil in accordance with international standards, due to the increasing number of sensory evaluation panels and their need to operate correctly.

We look forward to increasing the number of participants in scholarships funded by the IOC in the field of sensory evaluation of olive oil and olive oil technology. We aspire to increase our active participation in arbitration in the Mario Solinas Quality Award. We are also looking for scientific and practical ways to activate the two panels for the sensory evaluation of table olives.



Finally, we emphasise that the sensory evaluation of olive oil is one of the most important ways to distinguish between high and low quality olive oil, and the grading of olive oil is based on the commercial classification issued by the IOC, which is based on physical, chemical, and sensory analyses.

PLANTING SYSTEMS OF OLIVE GROWING IN JORDAN

Eng. Kawlah Al-Malkawi

Eng. Moain Al-Zureika

These days, cultivating olive trees in Jordan requires modern and economically viable planting systems that allow for an early, abundant, and consistent fruiting in order to make the investment profitable. From a social and economic point of view, the goal of minimising the use of manpower is becoming increasingly important, not only in order to contain costs, but also due to the difficulty in finding specialised labour as a result of the gradual depopulation of rural areas.

For olive growing more than any other tree crop, the levels of income achievable with current traditional groves – which are characterised by large and randomly-spaced trees – are often low due to the extensive use of labour. Hence, the survival of this important production sector is linked to the possibility of fully mechanising harvests and, albeit partially, pruning operations. Indeed, these are the only management practices still carried out today with an extensive use of labour, and they compromise the economic sustainability of the entire production process. To contain labour costs and increase profits, olive growers now also accept production on alternate years, thus reducing harvesting work.

The need to identify alternative olive planting systems to the traditional ones has become imperative. They must combine the advantages of integral mechanisation with the sustainability of the production line. Specifically, a modern olive growing system must include the possibility to use local cultivars that adapt well to climate and soil settings as well as the adoption of precision farming techniques to reduce production costs.

Planting Systems in Jordan

Jordan has three planting systems for olive groves: traditional, intensive, and super- intensive. Below we will highlight their main characteristics, relative strengths and weaknesses as well as their fundamental aspects.

1. Traditional Plantings

The traditional olive cultivation system is the most widespread in Jordan. Here, the olive tree is reliant on human intervention since no mechanisation or artificial irrigation is possible. Consequently, they are crops with a low density of trees (between 80 and 120 per hectare) following a grid pattern of 10-12 meters between the vertices where the olive trees are planted, and the olive groves are dozens of years old and even some centuries old.

From the point of view of production, the main disadvantages of traditional planting systems lie in the marked alternate bearing, which is caused by the age of the trees as well as economic factors. Mechanised harvesting operations in these situations are not always easy, which is the main reason for the economic inefficiency of these systems. Indeed, the size of the trees often makes using trunk shakers and/or rod vibrating combs difficult. In addition, there are further limitations related to the location of the plantings themselves (areas difficult to reach) and the layout of the land (steep slopes), which often makes harvesting the product directly from the ground (mechanical picking) or from nets the only feasible practices.

Due to the large size of the trees, fruit is generally harvested by laying nets on the ground, rarely with the aid of machines, on which the drupes drop naturally. Where conditions make it possible, facilitators, vibrating combs mounted on mechanical arms or limb shakers induce the detachment of the fruit. In such cases, harvest operations require the use of many people. The trees are shaken to drop the olives directly on the ground, fruit is then aligned with small windrowers and finally collected with pickers directly loading the olives in boxes. Afterwards, in the best case scenario, the leaves and soil are cleaned off the olives with sorting machines operating in the field before they are loaded into bins and transferred to the mill. Pruning is particularly dangerous, especially when the olive grove is located on steep, rocky or terraced grounds, due to the need to use ladders to reach the top of tall trees.

Pesticide treatments involve the use of large volumes of water, which, to reach the top of the trees, are sprayed with long-range spears; this operation often determines the drift and run off of pesticides on the ground and, consequently, a high polluting impact on the environment.

The traditional mechanisable system corresponds to land with less than a 20% slope, where it is possible to mechanise some of the most expensive tasks, such as harvesting or foliar treatments. In these plantations it is possible to switch to intensive cultivation, leaving the olive trees with only one foot and planting more olive trees among the old ones, thus achieving a higher density of plants per hectare.

2. Intensive Plantings

Within these typologies fall olive orchards characterised by planting densities of 300–1000 trees/ha, with trees arranged in squares or rectangles, depending on the planting density, and the training form adopted. Due to the wide range of planting densities that can be adopted, three different categories of intensive plantings can be distinguished: low, medium, and high planting density.

The intensive olive cultivation system consists of isolated olive trees with cups in the shape of a glass, young single-foot olive trees placed in frames of 6x6 or 6x3 meters, with 6m wide streets or corridors between them. The lifespan of the plants has been proven to exceed 40 years, so plant renewal is not required with the same frequency as can be seen in the super intensive system.

In the low planting densities, i.e. up to a maximum of about 400 plants/ha, the trees are generally arranged in squares at a distance of 5–7 m and trained to 3-D forms. The harvest is carried out with machines that are either self-propelled or coupled to the tractor, which uses a hook and shaking head applied to the trunk.

The possibility of reducing the number of people assigned to each harvest site to no more than two makes this system very interesting.

3. Super-Intensive Plantings

This is the last method of planting and it is characterised by a very high planting density (about 3,000 trees/ha). This system consists of rows of olive trees arranged as a fence, with planting distances of 1.35 x 3.75 or 1.5 x 4 meters with streets no more than 4 meters wide. One of the main advantages of super-intensive plantings lies in the possibility of harvesting olives with fully mechanised continuous systems. For this operation, the same straddle machines employed for harvesting grapes are used. Major advantages of super-intensive plantings lie in (1) the early and abundant fruiting that is achieved starting at 3–4 years from planting; (2) the speed of harvesting (2–3 h/ha) and pruning; (3) the stability of production (on average 1.5 tons of oil/ha/year). The planting system is nowadays supported by standard cultivation protocols that facilitate its management.

The greater efficiency of super-intensive plantings compared to other systems, however, shows all its weaknesses in countries where olive growing is mostly practised in the hills, on sloping land, in small farms (on average two hectares) and where water availability is modest and discontinuous and relies on small reserves accumulated during the winter. Other major limitations of this system lie in the fact that currently, they can only be established in irrigated areas and with a rather narrow range of cultivars.

THE MAJOR PESTS AFFECTING OLIVE TREES IN JORDAN

Eng. Haya Alwreika

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Eng. Mansour Shqerat

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Jordan is one of the countries in the Middle East whose climatic conditions enable the cultivation of olive trees. Olive trees are very important in Jordan, as they are considered one of the most fruitful and economic plantations, and the olive industry has experienced tremendous progress over the years.

However, olive cultivation and production face many problems, the most significant of which are pests, mites and pathogens, whether bacterial, fungal, or viral, and diseases caused by nematodes.

Among the most serious diseases are:

1. Olive fruit fly

Bactrocera (Dacus) oleae.

Diptera: Trypetidae

The olive fruit fly is one of the most notable insect pests that attacks olives, as it causes great losses that may reach more than 60% at high infestation. But the infection varies in severity from one year to another, from one olive cultivar to another, and from one region to another. It is widespread in all olive-growing regions in the Kingdom. The insects attack olives in Jordan from the beginning of summer until the fruits are collected in the autumn. The fly has four distinct life phases: full insect, egg, larva, and pupal. The length of the phases and its life cycle depend on temperature, food quality and other environmental factors.

Integrated control methods and extension programmes are used in Jordan to reduce the infestation of the pest and limit its spread:

Training courses for farmers and technicians:

Given the importance of identifying the pest in order to follow correct agricultural practices and choosing the most appropriate and effective control method, training courses are constantly organised as part of an integrated management approach to combating the olive fruit fly, targeting farmers and technicians working in olive cultivation to teach them everything about this pest and ways to combat it.

Field trips:

To come up with a correct diagnosis of the infestation and in order to use the appropriate control method, periodic field tours are carried out by farming specialists in order to monitor the emergence of the pest. Through field tours, farmers are educated and instructed on the necessary control measures.

Traps:

One of the methods used to control the pest consists of locally manufactured food and color traps plus Torula yeast tablets for their role in catching whole insects and reducing infestation. This means that using insecticides is not the main option for controlling this pest. The resulting product is free of residual pesticides, which makes it fit for human consumption as well as safe for the environment.

- The number of traps is 5-7 per dunum. This changes after 4-8 weeks for food traps and after a month for colour traps.
- Installation in the second third of the tree's height, in a shaded place, on the southwest side in spring and summer, and on the southeast side during autumn and winter.
- How attractive food traps work:
  Troll yeast: dissolve 2 tablets with a little water in a 1.5-litre water bottle, then continue adding water up to 300 ml after punching 5 holes in the top of the package, with a diameter of 0.5 ml, that will allow only the insect to enter.

- Locally manufactured food: dissolve 20 gm + 10 gm yeast with 300 ml water in a 1.5 litre water bottle.

Chemical control:

Only specialised insecticides registered with the Jordanian Ministry of Agriculture are used, such as deltamethrin 2.5%, malathion 57%, and others.

Use of topical spray for partial control:

This method consists in using a protein hydrolysate mixed with an effective insecticide to reduce the pest population with a long-term effect. It does not lead to the expulsion of the insect and the killing of parasites.

2. Olive branch knot disease (olive tuberculosis)

Pseudomonas savatanoi pv.savastanoi Bacterial pathogen.

The disease of the olive branch complex (olive tuberculosis) is one of the most dangerous bacterial diseases to affect olive trees. The infection reduces oil output, renders it unpalatable and reduces the size and number of fruits, thus causing great economic losses. Symptoms of the disease appear on old trees, especially branches and twigs that are between two and three years old, in the form of tuberous growths and small, irregularly rotated warts.

It occurs in various regions of the Kingdom. The disease's activity and development is suited to the warm weather and low rainfall, as well as the wounds resulting from incorrect agricultural operations and the failure to sterilise the pruning tools during the tree pruning process.

Integrated control methods (IPM) and guidelines used in Jordan to reduce the incidence of the disease and limit its spread include:

1. Field survey of the injured spots:

By conducting an annual field survey of olive orchards to limit the areas affected by the pest and therefore take preventive and remedial measures to limit the spread of the disease.

2. Qualification and Training:

This is done through the organisation of training courses for farmers to improve their technical skills in dealing with the pest, and teach them methods for preventing it and correct agricultural practices.

3. Organisation of field tours:

These aim to educate and guide farmers to take preventive measures to limit the spread of the disease, which include:

- Removing the infected parts, collecting them, and then burning them directly outside the orchard.
- Excision of tumors from infected small branches and nodes from large branches with a sharp knife and disinfection of their sites with Bordeaux mixture or with tar material mixed with copper sulfate.
- Carrying out the correct agricultural practices and not inflicting wounds on olive trees.
- Sterilisation of pruning tools when moving from one tree to another using formalin solution or an alcohol solution.
- Not taking scions from infected trees to monitor nurseries.
- Preventing sheep from grazing in endemic areas.
- Coating tree trunks with shingles 1-2 times a year to sterilise the stem and protect it from infection.
- Cultivation of disease-resistant cultivars and use of infestation-free plants.
- Resisting the olive fruit fly by using insecticides to prevent its spread.
- Spraying trees with Bordeaux mixture during the months of November, December and March.
- Conducting a chemical control process using copper fungicides (copper oxychloride) at a rate of two sprays, the first in spring before flowering and the second in fall after picking fruits.
- Issuing guidance brochures for farmers on how to identify the disease and ways of preventing it.

4. Chemical control:

Using copper fungicides, with a copper concentration of no less than 50% of the pesticide composition, with a first spraying in the spring and a second in the fall after harvesting. It is also preferable to spray immediately after the pruning process.

There are some pests and diseases that appear on trees, but they do not affect production economically. The percentage and severity of infection for each vary from year to year, the most important of which are:

4. Stone-pit olive scale

Pollinia pollini

5. Leopard Moth

Zeuzero pyrina

6. Olive beetle

Phloeotribus oleae

7. Olive Psyllid

Euphyllura olivine


1


2


3

IMAGE 1:
Zeuzera Pyrina butterfly (author, Rasbak)

IMAGE 2:
Pollinia pollini (**author**, Joaquim Alves Gaspar)

IMAGE 3:
Zeuzera Pyrina caterpillar (author, Alfred Comin)

Source: Wikimedia Commons

SURVEY ON THE PRESENCE OF *XYLELLA FASTIDIOSA* ON OLIVES IN JORDAN

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The olive tree (*Olea europaea*) is the most economically important fruit tree in Jordan; it contributes to the domestic produce and olive cultivation is a source of income for many Jordanian families.

Xylella fastidiosa is a Gram-negative, xylem-inhabiting, vector-transmitted, very slow-growing bacterium that has been proven to cause economic losses in many important crops, including grapevine, peach, plum, olive and many shade trees.

X. fastidiosa causes various plant diseases, including Pierce's disease, phony peach disease, citrus variegated chlorosis, olive quick decline syndrome, almond leaf scorch, leaf scorch diseases of many shade trees and other disorders of perennial crops and landscape plants. Olive quick decline syndrome is a destructive disorder that appeared suddenly a few years ago in Apulia, Italy, and spread to other areas. Symptoms of the disease include leaf scorching, wilting of the foliage, defoliation and premature leaf drop leading to branch decline and finally the death of the entire tree. Symptoms usually appear on just a few branches but later spread to cover the entire plant. Bacterial infection can be as severe as to lead to the death of the infected plant, but infections are frequently asymptomatic in several hosts and plants can remain asymptomatic for long periods.

There is growing concern over the potential of *X. fastidiosa* to spread and become established in the Mediterranean region by affecting a significantly high number of host range species. In 2016, the Jordanian Ministry of Agriculture banned the import of potential hosts of *X. fastidiosa* plant materials to stop it from entering Jordan. Plant materials imported during the 2013–2015 period were not inspected for *X. fastidiosa*. In case of occurrence of *X. fastidiosa* in Jordan, this may be due to symptomless infection before that period or entry during the 2013–2015 period. In parallel to a quarantine programme, a survey was organised to detect *X. fastidiosa* on olive trees in Jordan.

The bacterium *Xylella fastidiosa* is a destructive pathogen that attacks a wide range of more than 350 host plants, causing various diseases. Recent confirmation of the presence of *X. fastidiosa* on olives and other major crops in many countries in the European Union and other countries in the region was a serious threat to the Jordanian olive sector. A survey was conducted in 2018–2019 on the presence of this bacterium in olive growing regions all over Jordan. Samples were taken from olive trees showing suspected symptoms and from asymptomatic trees, and in total some 975 plant samples from different regions, in addition to potential insect vector samples, were collected. All plant samples were tested for the presence of *X. fastidiosa* using commercial Elisa kits, followed by molecular confirmation by conventional PCR. Insect samples were tested using a commercial kit with real time LAMP PCR. No positive samples were found, suggesting that *X. fastidiosa* is not present in Jordanian olive orchards. However, an extensive monitoring programme and border checks are needed to prevent the entrance of this pest into the country.

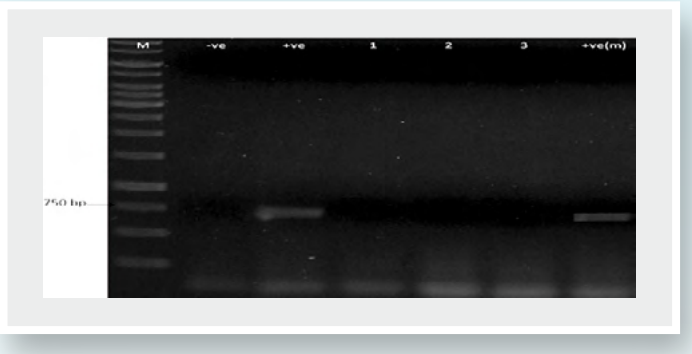


Figure 1. Agarose gel electrophoresis of PCR products of RST31/RST33 primers reaction. Non-template control (lane –ve), gDNA of *X. fastidiosa* (laneþve), tested samples (representative samples lane 1-3), gDNA of *X. fastidiosa* macerated with plant samples (laneþve) M: 1.5KB DNA ladder.

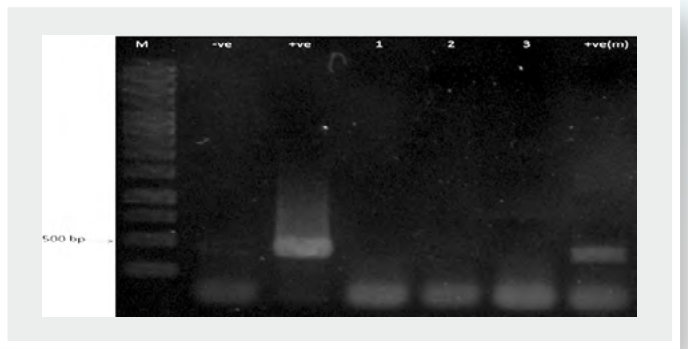


Figure 2. Agarose gel electrophoresis of PCR products of FXYgyr499/RXYgyr907 primers reaction. Non-template control (lane –ve), gDNA of *X. fastidiosa* (laneþve), tested samples (representative samples lane 1-3), gDNA of *X. fastidiosa* macerated with plant samples (laneþve) M: 1.5KB DNA ladder.

EFFECTS OF THE PLANTING LOCATION (ELEVATION) ON FATTY ACID COMPOSITION IN JORDANIAN OLIVE OIL

Dr. Saleh Al-Shdiefat

Jordan has a Mediterranean climate with hot, dry summers, and cool, wet winters. About 75% of the country, however, has a desert climate with annual rainfall of less than 200 mm.

Jordan can be divided into three main geographic and climatic areas: the Jordan Valley, the Mountain Heights Plateau, and the eastern desert, or Badia region. The Jordan Valley, known in Arabic as the "Ghor", is the most fertile area. It extends from the northern border (212 meters below sea level) down to the Dead Sea (407 meters below sea level), while the highlands separate the Jordan Valley and its borders from the plains of the eastern desert. This region spans the entire length of the western part of the country. These areas receive Jordan's highest rainfall, and are the most richly vegetated in the country. Elevation in the highlands varies considerably, from 600 meters to about 1,500 meters above sea level, with temperature and rainfall patterns varying accordingly.

There are different environments and altitudes in Jordan, and they each have a different effect on olive oil properties and fatty acid composition, thereby affecting the quality of olive oil itself.

The results of the study showed that the ratios of fatty acids can vary significantly depending on the degree of elevation above sea level. This confirms that the geographical and climatic environment has an impact on the quality of olive oil due to the differing fatty acid ratios in the four planting areas. The mean concentration of fatty acids in olive oil from these four planting areas is therefore not equal. In general, a significant difference can be observed in fatty acid concentrations (compared to their standard concentration: please refer to table 1) depending on the planting location of olive trees, given that fatty acids in olive oils from each location work together in a balanced, integrative manner.

Table 1. Average rate of fatty acids (%) in olive oil samples in 4 areas in Jordan

Fatty Acids		Average % of the main fatty acids in the studied areas*				Fatty Acids Standars
		Madaba (+785 m)	Subaihi (+490 m)	Kufranja (+680 m)	Jor. Valley (-230 m)	
C14:0	Meristic Acid	0.01	0.02	0.01	0.03	0.03
C16:0	Palmatic Acid	16.7	13.3	14.3	18.4	7.50 – 20.0
C16:1	Palmatiolic Acid	1.38	0.90	0.80	1.57	0.30 - 3.50
C17:0	Heptadcanwick Acid	0.07	0.18	0.18	0.16	0.30
C17:1	Heptadsenwick Acid	0.07	0.21	0.23	0.20	0.30
C18:0	Stearic Acid.	2.39	3.65	3.33	3.26	0.5 - 5.0
C18:1	Oleic Acid	61.9	64.2	67.7	54.5	55.0 -83.0
C18:2	Linoleic Acid	15.9	15.6	11.8	19.4	2.50 – 21.0
C18:3	Linolenic Acid	0.81	0.90	0.78	1.24	1.00
C20:0	Aracidic Acid	0.41	0.55	0.48	0.57	0.60
C20:1	Gadoleic Acid	0.21	0.34	0.29	0.26	0.40
C22:0	Bhenic Acid	0.02	0.04	0.01	0.05	0.20
C24:0	Alginoseric Acid	0.10	0.11	0.09	0.11	0.20

Fatty acid composition plays an important role in determining the stability of olive oil during storage and also has an impact on its nutritional value. Table 1 shows that the ratios of the main fatty acids found in olive oil (oleic, palmitic, linoleic, linolenic, and steric acid) fall within the international and local standard limits for olive oil set by the International Olive Council (IOC, 2015), and these values are slightly different depending on the area elevation. Oleic fatty acid (single unsaturated) is the main and most important acid in olive oil composition. It typically allows olive oil to be conserved and stored for long periods of time compared to other vegetable oils, and it also increases its nutritional value. It helps form emulsions in the gastrointestinal tract and promotes bile channel secretions. Olive oil also regulates cholesterol

levels in blood and reduces the incidence of heart diseases due to the high content of single-saturation acids and polyphenols. The mean values of this fatty acid ranged between 67.7% and 54.8% in Kufranja and Jordan Valley oils, respectively. Olive oil samples from the Kufranja area show a significant positive advantage over the remaining surveyed areas in terms of oleic acid percentage. Results also corroborated the differences between the surveyed samples in terms of fatty acid composition. Such discrepancies are due to environmental differences between the surveyed areas where olive trees are planted.

Percentages of palmitic acid in the studied olive oil samples ranged between 13.3% and 18.4% for the Subaihi and Jordan valley areas, respectively. Linoleic and linolenic fatty acids are essential fatty acids that the human body is unable to produce and which enter into the cellular membranes and regulate the metabolism of cholesterol in the body. It is desirable for these to be found in table olives; they are, however, not suitable for storage (especially linolenic acid) because they are unsaturated.

Many unsaturated fatty acid compounds are known to be unstable. However, the presence of antioxidants – phenols and tocopherols – reduces the free radical effect. Therefore, as can be seen in Table 1, olive oil samples from the Jordan valley are more susceptible to oxidation. Due to an increased percentage of total unsaturated fatty acids (and especially in the presence of oxygen, high temperatures, and light), therefore, they are less suitable for storage than the other studied samples.

Finally, the different ratios of fatty acids in olive oil – depending on elevation – lead to a great diversity in quality. Olive oil from highly elevated areas is of good quality and can be conserved and stored for long periods of time.

DEVELOPING A METHOD FOR THE DETERMINATION OF POLYPHENOLS IN JORDANIAN OLIVE OIL

Dr. Diya Alsafadi

Phenolic compounds are responsible for the nutritional and sensory qualities of extra-virgin and virgin olive oil. Following a request from the European Commission, the European Food Safety Authority (EFSA) approved a health claim stating that the dietary intake of olive oil polyphenols can prevent low density lipoprotein (LDL) oxidation.

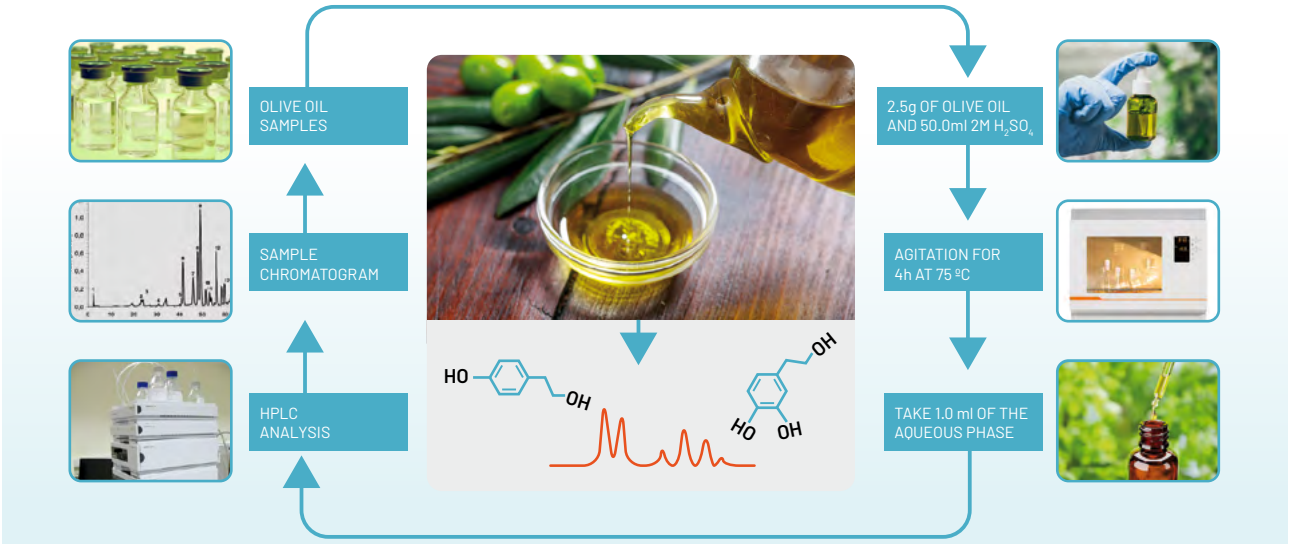
EFSA considered that in order for olive oil to bear the "heart-health" claim, 5 mg of hydroxytyrosol and its derivatives (e.g. oleuropein complex and tyrosol) in olive oil should be consumed daily. Following the announcement of the EFSA health claim, many studies were organised to quantify phenolic compounds in olive oil samples from many countries, such as Spain, Italy and Greece.

Jordan is one of the world's leading producers of olives and olive oil, with more than 15 million olive trees. In 2019, around 34,500 tons of olive oil were produced from Jordanian farms.

Despite the strong scientific background on health benefits related to phenolic compounds present in olive oil, this is not used to market Jordanian olive oil, because of the lack of information about the type and amount of phenolic compounds present in Jordanian olive oil.

This study set out to investigate the level of phenolic compounds in olive oils from different Jordanian cultivars. To satisfy this objective, a collaboration between the Royal Scientific Society and a local olive oil company, the Alzyoud olive mill company, was established. The study was supported by the Industrial Research and Development Fund/The Higher Council for Science and Technology in Jordan. The olive oil samples from different locations in Jordan (north, middle and south), of different cultivars (Nabali Baladi, Nabali Muhasen, K18 and Rumi) and different harvesting times (October, November and December 2019) were taken and analysed.

Firstly, a robust and simple method for hydrolysis and extraction of the major phenolic compounds including tyrosol (Tyr) and hydroxytyrosol (Htyr) and its bound forms from olive oil was developed. The conditions for hydrolysis and extraction were optimised; they included temperature, acid type/concentration, organic solvents and time. Maximum total phenol recovery was achieved using 2M sulfuric acid as extraction/hydrolysis solvent. The sample was incubated for 4 hours at 250 rpm, 75 ºC. The method showed satisfactory linearity (r2 > 0.99), precision (percentage relative standard deviation (%RSD) values < 3) and recoveries > 95% for both Tyr and Htyr. Limits of quantification (LOQ) were 0.56 and 0.70 mg/L for Tyr and Htyr, respectively. The validated method was applied to the collected samples. In general, samples harvested in early October showed higher total phenol content than samples harvested in November and December. The phenol content for samples obtained from different cultivars and locations were varied and the highest value (421 mg/kg) was recorded for the K18 sample harvested at an early stage time (20th October) from the Azraq area. The lowest phenol value (23 mg/kg) was recorded for the Nabli Muhasen cultivar, which was harvested from the same area and at the same time. The study showed that the quantity of phenolic compounds in olive oil depends on several parameters, such as cultivar, degree of maturation and climatic conditions. Results also showed that there are numerous Jordanian olive oil samples that have reached the minimum amount of 5mg/20goil requested by the EFSA in order to apply the health claim. The simple and accurate measuring of the amount of phenolic compounds in olive oil will assist in the application of the "olive oil polyphenols" health claim in the markets, and allow olive oil producers to certify the highest quality of virgin and extra virgin olive oil.



CHEMICAL COMPOSITION AND QUALITY CHARACTERISTICS OF JORDANIAN OLIVE OIL

Dr. Salam Ayoub

Eng. Ibrahim Alamad

Eng. Zein Khreisat

Eng. Sonia Damer

Olives (*Olea europaea* L.) are a major horticultural crop in all of the Mediterranean region, including Jordan. They are by far the most extensively cultivated crop in Jordan covering an area of 57,000 ha, which represents about 72% of the total area planted with fruit trees.

Olive cultivars are described by a combination of morphological, molecular, and biochemical characteristics, and genetic markers. Agronomic characterisation also enables classification of different olive cultivars.

In Jordan the main autochthonous cultivars are 'Nabali Baladi', 'Nabali Muhassan', 'Souri', 'Rumi', and 'Nasouhi Jaba'. However, several clones of these cultivars bearing different denominations and found in different areas of Jordan have been described.

Today, due to either confusion in traditional terminology or to the loss of genetic diversity, few local varieties of the major cultivar groups can be found in the groves, and most are limited to locations with specific environmental conditions. The current study aims to characterise some local traditional olive cultivars using a set of morphological descriptors and oil chemical profiles. Four olive cultivars, namely Nabali Baladi, Nabali Muhassan, Souri and Rumi, were studied in different locations in Jordan (Table 1).

Table 1. Location of selected olive cultivars

No.	Grove location (Village, Governerate)	Cultivar name
1	Al-Kfarat, Irbid	Nabali Baladi
2	Al-Jazazeh, Jarash	Nabali Baladi
3	The Castle, Ajloun	Souri
4	Al-Jazazeh, Jarash	Souri
5	Al-Hashemia, Ajloun	Rumi
6	Al-Gazalat, Al-Balqa	Rumi
7	Al-Jazazeh, Jarash	Nabali Muhassan
8	Al-Sbehi, Al-Balqa	Nabali Muhassan

Measurements of fruit weight, length and width, and stone weight, length and width, as well as fruit flesh to stone ratio indicated significant differences between olive cultivars from different locations. Results of fruit weight indicated significant differences between different locations for different cultivars. Thus Nabali Muhassan (Al-Sbehi, Al-Balqa) and Souri (the Castle, Ajloun) had the highest fruit weight, while Nabali Baladi (Al-Jazazeh, Jerash), Souri (Al-Jazazeh, Jerash) and Rumi (Al-Hashemia, Ajloun) had the highest stone weight. Nabali Muhassan showed the highest flesh to stone ratio. Fruit moisture content (%) was the highest for the Nabali Muhassan cultivar; however, both Nabali Baladi and Souri gave the highest fruit oil content based on dry weight.

Results of oil quality measurements are shown in table 2. In general, olive oil extracted from all cultivars under study were within the extra virgin olive oil classification, even though significant differences were found between cultivars in oil free acidity (e.g. Souri/Ajloun, Rumi and Nabali Muhassan), and also in peroxide value (e.g. Souri/Ajloun, Nabali Baladi/Irbid and Nabali Muhassan). On the other hand, high total polyphenol contents were found in olive oils of Nabali Baladi and Rumi/Al-Balqa compared to other cultivars. However, Souri and Nabali Muhassan cultivars fall within the medium category of polyphenols content. Vitamin E content was significantly the highest in oil obtained from Souri/Jerash and Rumi/Al-Balqa cultivars.

Regarding olive oil fatty acid composition, data showed significant differences between cultivars in stearic acid, linoleic acid and linolenic acid. However, no significant differences were observed in oleic acid content between cultivars. On the other hand, significant differences were found between the same cultivars from different locations. It is the case in Souri with linoleic, linolenic and behenic acids; in Rumi for linoleic acid; and in Nabali Muhassan for linoleic acid.

The differences in morphological and biochemical characteristics among olive cultivars in this study could be attributed to the cultivars' genetic factors, without neglecting the influence of environmental conditions varying between locations.

Table 2. Free acidity, peroxide value, total polyphenols, vitamin E, fatty acids composition of olive oil extracted from different olive cultivars grown in different locations

CULTIVAR	Nabali Baladi	Nabali Baladi	Souri	Souri	Rumi	Rumi	Nabali Muhassan	Nabali Muhassan
LOCATION	Irbid	Jerash	Ajloun	Jerash	Ajloun	Al-Balqa	Jerash	Al-Balqa
PARAMETERS								
Free acidity as oleic acid (%)	0.51 ab	0.52 ab	0.73 a	0.56 ab	0.62 ab	0.39 b	0.41 b	0.38 b
Peroxide value (mEq O_2 /Kg oil)	4.62 b	6.95 ab	8.61 a	6.94 ab	7.32 ab	4.23 c	5.30 bc	4.16 c
Total Polyphenols (mg/Kg)	545.16 a	457.38 b	366.08 c	376.61 c	284.44 d	432.79 b	224.74 d	208.45 d
Vitamin E (mg/Kg)	176.2 b	163.9 b	111.9 c	234.5 a	188.1 b	218.9 a	177.7 b	162.8 b
FATTY ACIDS COMPOSITION (%)								
Myristic acid C14:0	0.01 a	0.02 a	0.01 a	0.01 a	0.01 a	0.01 a	0.02 a	0.02 a
Palmitic acid C16:0	12.71 a	13.25 a	12.61 a	13.39 a	12.13 a	12.08 a	13.93 a	13.79 a
Palmitoleic acid C16:1	0.59 b	0.71 ab	0.57 b	0.65 b	0.53 b	0.49 b	0.83 a	0.90 a
Heptadecanoic acid C17:0	0.21 a	0.19 ab	0.15 b	0.18 ab	0.23 a	0.26 a	0.05 b	0.12 b
Heptadecenoic acid C17:1	0.24 a	0.22 a	0.18 b	0.21 a	0.25 a	0.28 a	0.06 b	0.09 b
Stearic acid C18:0	4.06 a	4.13 a	3.89 a	3.80 a	4.38 a	4.72 a	2.89 b	2.67 b
Oleic acid C18:1	68.64 a	67.99 a	70.52 a	68.05 a	69.71 a	71.40 a	70.37 a	69.40 a
Linoleic acid C18:2	11.86 b	13.62 a	10.61 c	12.05 b	11.03 c	9.29 d	10.33 c	11.44 b
Linolenic acid C18:3	0.63 b	0.76 a	0.49 c	0.62 b	0.64 a	0.70 a	0.65 b	0.66 b
Arachidic acid C20:0	0.55 a	0.58 a	0.51 a	0.55 a	0.59 a	0.60 a	0.44 b	0.42 b
Gadoleic acid C20:1	0.27 a	0.29 a	0.27 a	0.29 a	0.32 a	0.31 a	0.26 a	0.27 a
Behenic acid C22:0	0.14 a	0.15 a	0.12 b	0.14 a	0.16 a	0.16 a	0.11 b	0.11 b
Lignoceric acid C24:0	0.07 a	0.08 a	0.06 a	0.08 a	0.08 a	0.07 a	0.06 a	0.06 a

EFFECT OF THE OLIVE CULTIVAR MATURATION INDEX ON THE CHEMICAL PROPERTIES OF OLIVE OIL

Dr. Murad Al-Maaitah

Dr. Khaled Al-Absi

Dr. Abdullah Al-Rawashdeh

Olive oil is the juice of olive fruits that is extracted by physical methods without damaging or affecting its nutritional value and without the addition of any chemicals or other substances. Therefore, olive oil is one of the main fatty substances used in contemporary nutrition, and the only one that can be used in its fresh state, which allows it to retain all its original ingredients.

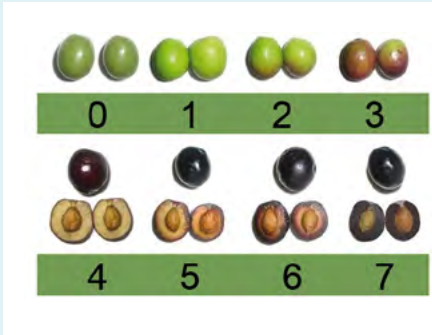
The chemical properties of olive oil are affected by several factors, including the variety, environmental conditions, maturation index, and the general condition of the fruits before and after harvesting, the method of harvesting used, the way of transporting the fruits to the press, and the time period during which the fruits remain untreated after picking. There are other factors related to the level of tree care in terms of fertilising, pruning and watering; all these factors are reflected in the general characteristics of the oil extracted from the fruits.

In general, with the progression of fruit ripening and the delay in harvesting, the acidity, peroxide value, and the percentage of oil increase, while there is a decrease in the moisture content of the fruits, the chlorophyll content of the fruits and the content of phenolic compounds, which have a negative effect on the organoleptic quality of olive oil. In addition, with the ripening of the fruits, many metabolic processes occur and the concentration and percentages of many compounds in the fruits become altered.

These changes are reflected in the quality, the organoleptic properties of the oil, its oxidative stability and its nutritional value.

Each Jordanian olive variety has its own chemical and sensory properties that distinguish it from others, and therefore all the factors mentioned above have a part to play in obtaining excellent virgin olive oil.

It was observed that when harvesting the fruits of the local olive cultivars, Nabali Baladi and Nabali Muhasen, at the same stage of maturity, geographical location, climatic conditions, agricultural services and extraction method have an effect on the chemical properties. This is shown in the analysis below:

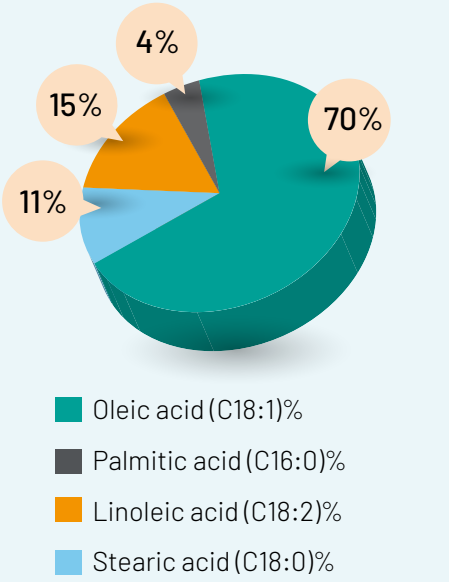


NABALI BALADI							
Maturation phase	Acidity %	Peroxide value mEq O_2 / kg oil	Totalphenols mg/kg	Tocopherols mg/kg	Squalene mg/kg	K232	K270
Phase 1	0.36	4.40	210	220	4587	1.38	0.16
Phase 2	0.38	6.40	228	241	5584	1.41	0.16
Phase 3	0.45	9.67	244	271	5989	1.44	0.18
Phase 4	0.55	9.80	305	306	6118	1.65	0.18
Phase 5	0.65	9.90	362	348	4847	1.97	0.19
Phase 6	0.72	9.74	301	252	3788	2.20	0.19
Phase 7	0.89	10.40	120	241	3477	-	-

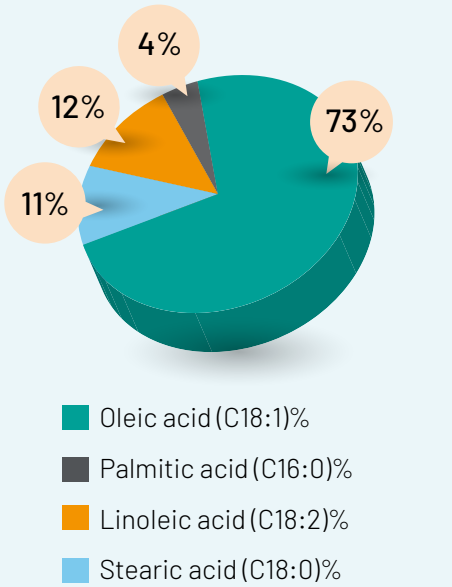
NABALI MUHASEN							
Maturation phase	Acidity %	Peroxide value mEq O_2 / kg oil	Totalphenols mg/kg	Tocopherols mg/kg	Squalene mg/kg	K232	K270
Phase 1	0.47	6.63	107	231	4871	1.35	0.16
Phase 2	0.59	8.53	111	247	5025	1.41	0.16
Phase 3	0.58	8.83	115	251	6089	1.49	0.17
Phase 4	0.65	9.00	210	262	6167	1.78	0.17
Phase 5	0.79	9.40	358	32	4917	1.93	0.19
Phase 6	0.89	9.83	298	241	3841	2.22	0.19
Phase 7	0.47	6.63	171	226	3519	-	-

The same is the case with the fatty acid content as the cultivars differ in their levels.

FATTY ACIDS IN NABALI MUHASEN



FATTY ACIDS IN NABALI BALADI



With regard to the sterols content, they are shown in the table below:

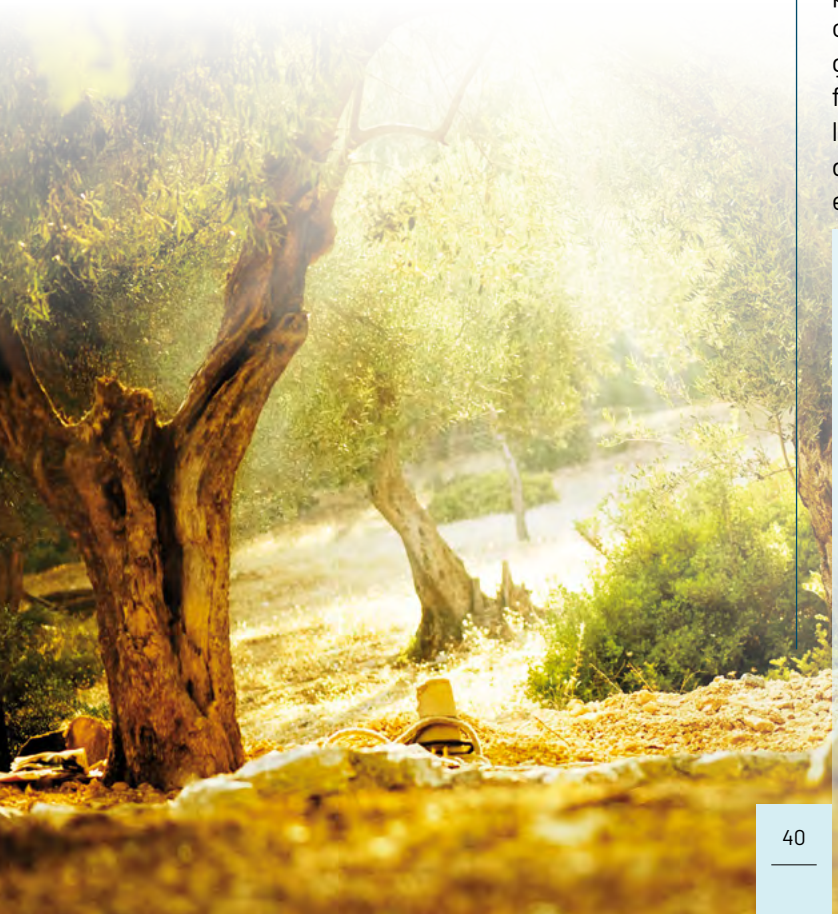
STEROLS	NABALI BALADI	NABALI MUHASEN
Cholesterol	0.08	0.06
24-methylene-cholesterol	0.28	0.14
Campesterol	3.45	3.13
Champestanol	0.08	0.02
Stigmasterol	0.80	1.17
Δ-7-campesterol	0.20	1.79
Δ -5,23-stigmastadienol	0.06	0.25
Clerosterol	1.12	0.87
β-sitosterol	87.8	86.5
Sitostanol	0.65	0.29
Δ -5-Avenasterol	4.64	4.89
Δ -5-24-stigmastadieno	0.45	0.36
Δ -7-stigmastenol	0.18	0.25
Δ -7-avenasterol	0.17	0.31
Erythrodiol & Uvaol	1.89	1.62

ORGANIC OLIVE FARMING IN JORDAN

Eng. Tamam Al-Khawalda

Organic agriculture is an environmentally sustainable agricultural production system which focuses on the best way to use environmental resources within a legal framework, avoiding the use of manufactured chemical pesticides and fertilisers, growth regulators and concentrated feed additives in order to produce healthy, clean food free from toxic chemicals.

Agricultural products are described as organic if compliant with a set of domestic standards and regulations as well as international standards governing production at all stages. Organic culture relies on crop rotation, natural fertilisers, crop by-products, green fertilisers, and organic waste to increasesoil fertility and improve the physical, chemical, and biological properties of the soil in order to increase productivity, decrease production costs and protect the environment.



Organic agriculture contributes to:

- Adding value to the animal and plant products.
- Offering environmentally safe and high-quality products to consumers.
- Finding new marketing opportunities that complement local and international market demands.

Regulatory legislation of Organic Agricultural in Jordan:

The Division of Organic Agricultural products was established in the Ministry of Agriculture (Plant Production Directorate) in 2002.

National Laws and regulations:

1. The definition of organic agriculture is included in the new Agriculture Law No. 13/2015.
2. Issuance of the organic farming bylaw No.133/2016 under Articles (7) and (71) of the Agriculture Law No. 13/2015.
3. Issuance of the Organic regulations no. (Z/5) /2017 under Article (10), Article (23) and Article (24) of the Organic Farming bylaw No. 133 /2016.

The total organic agricultural surface area in Jordan for 2021 was 14,775 dunom, while the total area for organic olives groves is 3,860 dunom. This includes 3 organic olive mills. There are domestic and external certification bodies for organic farming:

- Jordan Standards and Metrology organisation (JSMO)
- Ecocert
- Tuv. Nord integra
- CcPb

The first project in organic agriculture, which began in 2004 and ended in 2007, was the "Sustainable Agriculture (Organic Agriculture)" project in the Berma region in Jerash Governorate, funded by the Japanese International Cooperation Agency (JICA) and implemented by the Jordanian Ministry of Agriculture in cooperation with Japanese International Cooperation Organization for Local Community Development (NICCOD).

Project Achievements

- Participating farmers received their JAZ organic certification.
- Organic olive oil was marketed to the local market.
- Limited quantities of organic olive oil were exported to the Japanese market.
- Knowledge of organic farming techniques was increased and shared among Jordanian farmers.

The Ministry of Agriculture updated the national action plan (2018-2022) for organic agriculture and the most important achievements are:

- The establishment of a model unit that contains: open fields, plastic greenhouses, and organic olive groves.
- The organisation of 32 awareness workshops in cooperation with the Olive directorate. The target groups are students in primary and secondary schools and the aim is to encourage them to adopt olive trees and increase knowledge of the benefits of organic olive oil.

Why Jordanian Organic Extra Virgin Olive Oil?

Organic olive oil is the highest quality of all olive oils, with an acidity level below 0.8% and a peroxide value of less than 20 mEq/ kg. Our recent tests showed extraordinary results on the acidity analysis. We succeeded in maintaining acidity between 0.27% and 0.8%, with a peroxide value of between 7 and 9 mEq O_2/ kg.

Organic Extra Virgin and Extra Virgin Olive Oil are very similar in terms of quality, but one comes at a premium due to the organic documentation and certification process. The olives are grown and the oil is produced in a very similar manner either way. In addition, however, Organic Extra Virgin Olive Oil is more natural than its regular counterpart.

Nutrition Facts about Organic Extra Virgin Olive Oil

INGREDIENTS	EXTRA VIRGIN OLIVE OIL, UNREFINED, HANDPICKED OLIVE	
Acidity	< 0.8%	
Peroxide value	< 20 mEq O_2/ kg oil	
Nutrition Facts (Serving Size: 15ml)		
Calories	Amount per serving	120
Total Fat 14g	Daily Value	21%
Saturated Fat 2g		9%
Polyunsaturated Fat		1.5g
Monounsaturated Fat		10 g
Cholesterols 0mg	Daily Value	0%
Sodium 0mg	Daily Value	0%
Total Carbohydrate 0mg	Daily Value	0%
Protein 0g	Daily Value	0%
***Percent daily value is based on a 2000 calorie diet.**		

Organic Extra Virgin Olive Oil and health

Cold-pressed OEVOO plays an important role in skincare manufacturing. Olive Oil is found in 20 of our 33 products that include soaps, creams, shower oils and ointments. Its health benefits and soothing properties make it ideal for sensitive skins. All our products have been tested and approved by dermatologists and are suitable for sensitive and allergy-prone skin as well as babies and children.

Finally, Jordanian organic olive oil and its products are marketed in local and international fairs thanks to its desirable characteristics at the local and international levels.

COMPETITIVENESS OF OLIVE PRODUCTION IN JORDAN

Dr. Masnat Al-Hairy

Large numbers of olive farms are small and medium-sized and represent a source of income for many Jordanian families, as well as providing many seasonal job opportunities. Around 180,000 families receive some or all of their income from olive production. Productive trees make up 80% of the olive tree coverage in the country, with two main producing regions: the western mountains (rainfed), with 76% of olive plantations; and the eastern region (irrigated) with 24%. For decades, olive trees have been ahead of fruit trees with respect to surface area and production. From 1981 to 1994, the cultivated area with olives increased by 250%.

Olive production fluctuates from year to year for a variety of reasons, mainly the biennial bearing habit and rainfall variability. Output increased from 65 thousand tons in 1995 to about 129 thousand tons in 1996, fluctuated during 1997-1998, then dropped to 42.5 thousand tons in 1999, and sharply increased to about 185 thousand tons in 2000. The average production of olives between 2000 and 2005 was 164.3 thousand tons (Ministry of Agriculture, 1995-2005). An analysis of olive production trends from 1984-2003 indicated that it increased by 7.4 thousand tons per year.

The produce is harvested by hand and immediately stored in plastic and polystyrene boxes or in bags. The filled containers are then loaded on trucks and sent to the central markets or sold at roadside stands outside the major urban centres of Amman, Irbid and

Zarqa. Olive fruit pickling is done by hand or by machine. Most Jordanian families save table olives and olive oil as a kind of food security at home. The pickled table olives are placed in plastic or glass bottles (filling capacity 3-5 Kg) for storage purposes.

In the case of olive oil, the harvested fruit is allowed to drop onto a cloth or plastic sheet, which is placed under the tree. Stems, twigs and leaves are removed; the olive tree residues vary between trees and cultivars. The olive fruits are stored in plastic or polystyrene containers (filling capacity 7-10 Kg) or in bags (20 Kg or more) and then loaded in trucks and transported to the processing unit.

Olive oil in Jordan is mainly packed in metal containers (filling capacity 15 –17 Kg) for domestic markets. In some cases, glass and plastic bottles are used for export markets. Plastic storage containers are of course food grade and will not impart objectionable flavours or aromas.

The gap between local olive production and consumption was covered by imports mainly from the West Bank, Tunisia, and Spain. The average imported quantities of pickled olives amounted to 0.27 thousand tons for the period 1995-1999, increasing to 4.4 thousand tons in 2000, while imports of olive oil amounted to 1.7 thousand tons as an average for the period between 1995 and 1999. Jordan reached self-sufficiency in olive in 2000. The per capita consumption of pickled olives and olive oil amounts to 0.6 and 4.7 kg/yearly.

Olive products, including olive oil, pickled olives, and by-products of olive cake, leaves, and twigs, play a key role in the Jordanian agricultural economy due to their impact on the agricultural trade balance and on employment. In addition, the utilisation of olive by-products helps to enhance the economic efficiency of the olive sector and resolve arid environmental problems related to this industry.

The olive sector boasts investments valued at more than US $ 1.5 billion. The Policy Analysis Matrix (PAM) showed that olive oil (in terms of fresh olives) does not enjoy a comparative advantage; the DRCs are higher than one (Table 1). Olive production in Jordan can be competitive if we reduce the social costs of domestic resources, or reduce the social costs of

tradable inputs. Supporting research to reduce production costs, introducing new high-yield varieties, and developing advanced agricultural technologies that will lead to the reduction of production costs and increase crop productivity will help to increase olive competitiveness.

The effective protection coefficient (EPC) for the olive crop is greater than one, standing at 1.43 in Madaba, 1.44 in Jerash, 1.79 in Irbid, 1.38 in Balqa, 1.78 in Amman, and 1.43 in Mafraq governorates. This means that there are incentives for the agricultural product, as a result of the negative impact of the policy supporting agricultural inputs and outputs.

Table 1.

Governorate	Indicators				
	SRP	DRC	EPC	NPCI	NPCO
Madaba	%26	1.44	1.43	0.64	1.09
Jarash	%26	1.44	1.44	0.95	1.23
Irbid	%26	1.44	1.79	0.89	1.41
Balqa	%29	1.44	1.38	0.88	1.16
Amman	%29	1.44	1.78	0.98	1.44
Mafraq	%26	1.44	1.43	0.7	1.12

The nominal protection coefficient for input (NPCI) was less than one, standing at around 0.64 in Madaba, 0.95 in Jerash, 0.89 in Irbid, 0.88 in Balqa, 0.98 in Amman and 0.70 in Mafraq.

This means that there is a reduction in costs paid by olive producers as a result of the policy support provided, and domestic prices for inputs are lower than global prices.

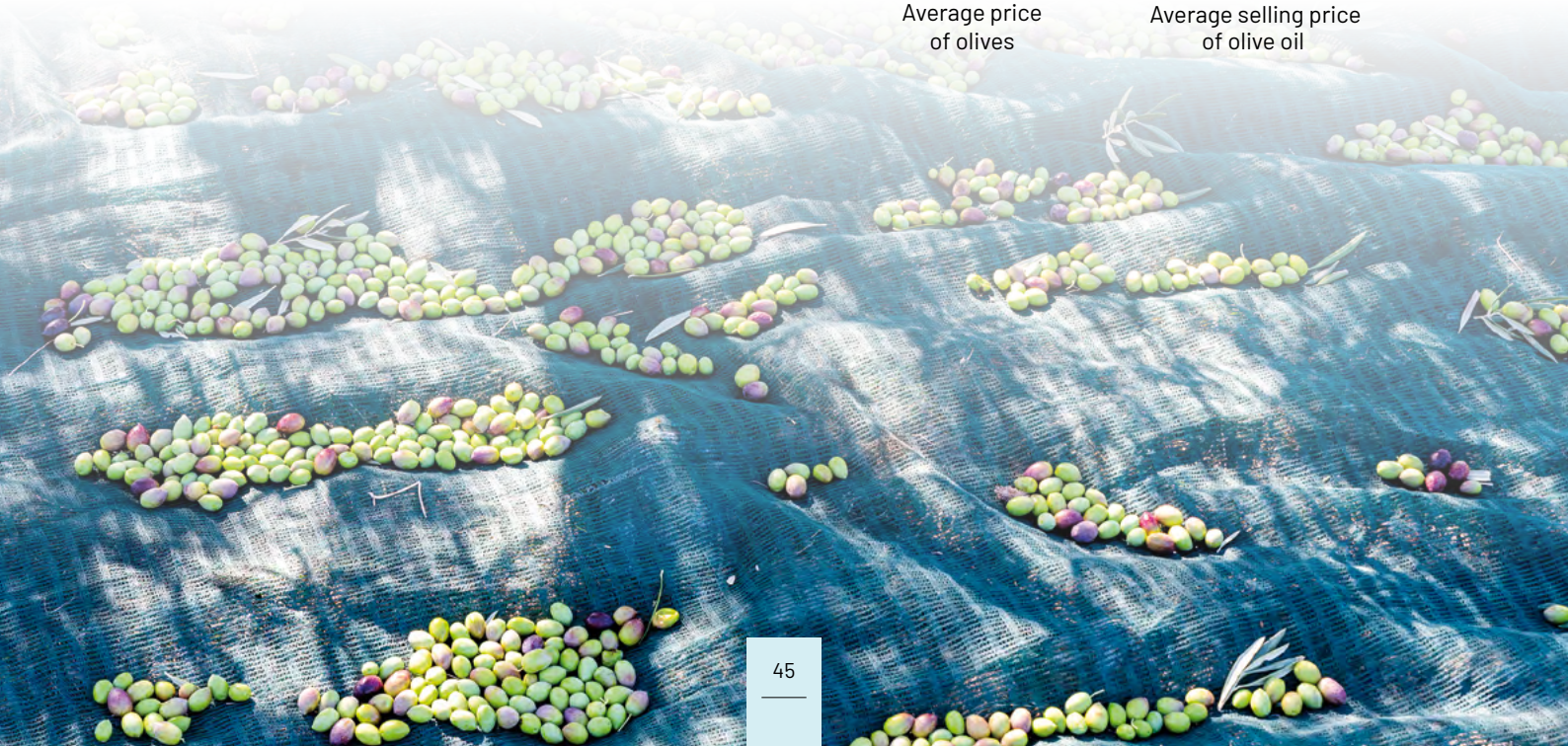
The rate of olive oil production per donum reached 63.5 kg and the average price of olives was US$ 1.4/kg, while the average selling price of olive oil reached 4.2 US$/kg. There are opportunities for Jordan to develop this sector. Jordan ranks eighth worldwide in olive production, but there are problems in the marketing of olive oil due to the absence of an entity responsible for its pricing and marketing, as well as rising operational costs. Therefore, there is a need to activate the role of the Ministry of Agriculture (technical advice, treatment, support and production inputs) and issue legislation to serve this sector.

63.5KG/DONUM
Olive oil production

8º
Producing country

US $ 1.4
Average price of olives

US $ 4.2
Average selling price of olive oil



OLIVE HARVESTING IN JORDAN

Eng. Raed Ahmad

Dr. Salam Ayoub

Olives, in Jordan, are usually harvested between November and January. Harvest time depends on many factors, including environmental conditions, plant variety and the purpose of harvesting.

When olives are harvested for green pickling, the fruits are picked when they have reached full size and their colour changes from dark green to light green. In contrast, fruits are harvested after about two weeks of completing their black coloration for the purposes of black pickling. But if the purpose of the harvest is oil extraction, then fruits are harvested when they are at least 75% black in colour.

With the development of the olive sector in Jordan and an increase in the area planted with olive trees, several challenges have come forth in the sector. More than 90% of olives in Jordan are still harvested by hand, and this is considered the most expensive stage in olive production (40-50% of production cost). Switching to mechanised harvesting could be a possible solution; at any rate, this is also necessary for sustainable olive production, since it lowers the cost of production and reduces the number of workers.

Methods of olive harvesting in Jordan:

Hand harvesting:

Most olives produced in Jordan are still harvested manually. The advantage of this method is that it does not damage the branches and fruits, but it requires many workers at a specific time. With the increase in the area planted with olives, a corresponding increase in the demand for manpower is expected in the near future, especially at harvest time, which will raise the cost of harvesting and increase wages.

Mechanical harvesting:

Some olive growers in Jordan have started using mechanical harvesting, which has given excellent and encouraging results. Because of the expansion of the area planted with olives, hand harvesting costs, and shortage of labour, farmers will be forced to seriously consider switching to mechanised harvesting.

Various types of harvesting machines, such as main branch shakers and comb machines, are available in Jordan. These small-sized machines are powered by electricity or by air pressure, which generates a vibrating movement of the plastic fingers installed on the combs. This vibrating movement on the olive branches causes the fruit to fall. These machines are equipped with a lightweight metal arm that can be easily lengthened and shortened, allowing the farmer to reach the olive fruits around the tree, wherever they are. These machines are characterised by their small size and light weight, which allows them to move easily in olive groves.

However, many trials have been carried out by the National Agriculture Research Centre in order to compare the efficiency of hand and mechanical olive harvesting, and evaluate their effects on trees, fruits, harvesting efficiency and productivity. One of these experiments was performed on three local olive cultivars: 'Nabali Balaldi', 'Nabali Mohassan' and 'Romi'. Five harvest methods were compared: manual, plastic comb, pneumatic comb machine, Karbonium electric olive harvester and hand-held branch shaker.

Harvesting productivity for the three harvesting machines used in this study were significantly higher than that for both manual and plastic comb harvesting methods for the three cultivars (Table 1).

Table 1. Effect of harvesting method on harvesting productivity and percentage of harvested fruits

TREATMENT	HARVESTING PRODUCTIVITY (Kg/ hr)			PERCENTAGE OF HARVESTED FRUITS (%)		
	Nabali Baladi	Nabali Mohassan	Romi	Nabali Baladi	Nabali Mohassan	Romi
Hand harvesting	7.30 D	9.90 C	7.80 C	99.1 A	98.9 A	99.1 A
Plastic comb	15.8 C	20.0 B	17.0 B	98.0 A	98.5 A	98.5 A
Pneumatic comb machine	28.3 AB	44.8 A	30.5 A	93.7 AB	93.7 AB	94.4 AB
Karbonium electric olive harvester	31.1 A	39.6 A	31.4 A	92.0 B	96.2 AB	92.0 B
Branch shaker	23.5 B	45.3 A	28.9 A	88.6 B	91.2 B	91.3 B

The mechanical systems increased harvesting productivity and hand-held shakers doubled productivity compared with hand harvesting. Also, results showed that hand harvesting had the highest percentage of harvested fruits for all the cultivars (Table 1). Harvester performance largely depends on crop load and fruit maturity, orchard management and cultivar characteristics.

Harvesting of olives by mechanical systems

The percentage of detached leaves for the three harvesting machines was significantly higher than that from hand harvesting. Injured fruits for the three mechanical harvesters were significantly higher than that for both hand and plastic comb harvesting methods for all the three cultivars (Table 2).

Table 2. Effect of harvesting method on percentage of injured fruits

TREATMENT	PERCENTAGE OF INJURED FRUITS (%)		
	Nabali Baladi	Nabali Mohassan	Romi
Hand harvesting	3.4 B	3.7 C	2.9 C
Plastic comb	9.3 B	8.4 BC	14.1 B
Pneumatic comb machine	28.5 A	19.4 A	24.4 A
Karbonium electric olive harvester	23.1 A	14.0 AB	24.0 A
Branch shaker	27.2 A	13.3 B	22.5 AB

Mechanical harvesting increases productivity four/fivefold compared to manual harvesting for all studied cultivars. Also, mechanical methods can be used in traditional olive orchards. Shifting to mechanical olive harvesting is necessary for an economically sustainable olive production.

Hand harvesting, plastic comb and karbonium electric olive harvester

OLIVE TREE REJUVENATION PRUNING

Eng. Raed Ahmad

Dr. Salam Ayoub

Old olive orchards exhibit a degraded canopy, imbalance between the leaf and the wood mass and minimal production capacity. They represent about 25% of olive trees in Jordan and their rejuvenation is very important for increasing production, improving fruit quality and consequently improving farmers' incomes.

These symptoms do not occur at a specific time in the lifespan of the tree, but are brought about by several factors in addition to age, the most important of which are soil type, rainfall, irrigation, fertilisation and pruning.

Symptoms of the old aging phase of olive trees:

1. Low productivity and small-sized fruits.
2. Severe alternate bearing phenomenon.
3. The stem of the tree is large in diameter.
4. Excessive extension of the main branches.
5. A tendency to give a good yield season only every few years.

A rejuvenation programme must be initiated for these trees in which vegetative growth has become weak, allowing for an increase in vigour and yield. Rejuvenation pruning is done in February and March before new growth starts.

Methods of rejuvenation pruning for olive trees:

1. **Pruning trees at the level of the main branches:** The main branches of the tree are cut in an area approximately 20 cm away from the main trunk.

   Pruning trees at the level of main branches will result in strong new growth and large numbers of shoots from the dormant buds, so that, during the growing season, a new tree structure can be obtained. In the next season, eight twigs are kept, provided that they are distributed over the skeletal branches, and the rest are removed and the tree begins production after four years.

2. **Pruning trees at the ground level:** The crown area is completely removed by cutting the trees at the ground level. During the first season, four of the new growths are kept – i.e. those which are best positioned – and the rest are removed. The tree enters the fruiting phase during the fourth and the fifth year.

3. **Regeneration of trees from underground part of the mother tree:** A small part (4 to7 kg in weight) is separated with its entire roots. The mother tree is kept for an additional 4-5 years so as to further benefit from its production, and then it is removed.

   This part is completely separated from the mother tree and covered with soil. After several weeks, a large number of buds will emerge from the stump. 3-4 of these new branches are selected and the rest are discarded.

   This method is particularly used if the tree is affected by a fire, or if it has been damaged as a result of snow, strong winds, or any mechanical injury.

4. **Renew old trees gradually:** Old trees are renewed gradually, over a period of four years, by removing one main branch every year.

   It is recommended that the affected area be painted with mastic in order to protect it from cracking and sunscald, while trunks should be painted white (Bordeaux mix) to protect them from strong sunlight. In case of excessive pruning, nitrogen fertilisation should be stopped for two years after renewal pruning, in order to reduce the formation of suckers.

A study was conducted in order to select the best rejuvenation method to be applied in order to rebuild canopies and restore productivity in old olive trees.

1. Cutting the whole tree back to the ground level and training three to five branches from the suckers (T1).

2. Rejuvenating the old tree gradually by removing one main branch per year (T2).

3. Rejuvenating the canopy from its crown shoots (T3).

4. Rejuvenating from the underground section of the trunk base (T4).

5. Control (traditional pruning) (T5).

Based on our results, all rejuvenation treatments significantly increased yield, fruit quality, shoot diameter, shoot length and canopy diameter.

Rejuvenating old trees gradually by removing one main branch per year or by regeneration from its crown shoots increased the yield four-fold. Moreover, all the quality parameters which were taken into account – such as fruit weight, fruit length and fruit width – improved after pruning. Rejuvenation pruning can be adopted to restore the productivity of old olive trees.

Table 1. Influence of rejuvenation pruning on fruit yield of Nabali Baladi cultivar. Values are for the third to fifth year after pruning

TREATMENT	AVERAGE YIELD (Kg/Tree)		
	After the third year of pruning	After the fourth year of pruning	After the fifth year of pruning
Cutting the whole tree back to the ground level and training three to five branches from the suckers / **T1**	2.95 CD	11.63 BC	2.95 CD
Rejuvenating the old tree gradually by removing one main branch per year/ **T2**	4.49 AB	18.93 A	4.49 AB
Rejuvenating the canopy from its crown shoots / **T3**	3.97 BC	14.85 B	3.97 BC
Rejuvenating from the underground section of the trunk base / **T4**	2.17 D	09.33 C	2.17 D
Control (traditional pruning) / **T5**	5.51 A	09.95 C	5.51 A
LSD	1.28	3.92	1.28

Table 2. Influence of regeneration pruning on fruit characteristics of Nabali Baladi cultivar. Values are from third to fifth year after pruning

TREATMENT	MEAN OF FRUIT WEIGHT (gm)	NUMBER OF FRUITS /Kg	MEAN OF FRUIT LENGTH (cm)	MEAN OF FRUIT WIDTH (cm)
Cutting the whole tree back to the ground level and training three to five branches from the suckers / **T1**	2.64 AB	363.1 BC	2.18 B	1.55 B
Rejuvenating the old tree gradually by removing one main branch per year / **T2**	2.82 A	342.7 C	2.42 A	1.55 B
Rejuvenating the canopy from its crown shoots / **T3**	2.86 A	336.1 C	2.38 A	1.58 A
Rejuvenating from the underground section of the trunk base / **T4**	2.52 B	388.6 B	2.17 B	1.45 C
Control (traditional pruning) / **T5**	1.94 C	517.1 A	1.88 C	1.41 D
LSD	0.27	26.6	0.13	0.0059

Table 3. Influence of regeneration pruning on average of canopy diameter

TREATMENT	AVERAGE CANOPY DIAMETER (cm)		
	After the third year of pruning	After the fourth year of pruning	After the fifth year of pruning
Cutting the whole tree back to the ground level and training three to five branches from the suckers/ **T1**	330.8 A	341.2 A	400.0 A
Rejuvenating the old tree gradually by removing one main branch per year/ **T2**	270.6 B	304.7 B	344.4 B
Rejuvenating the canopy from its crown shoots/ **T3**	265.5 B	280.1 C	335.7 B
Rejuvenating from the underground section of the trunk base/ **T4**	336.9 A	347.8 A	384.9 A
Control (traditional pruning) / **T5**	252.5 B	265.8 C	276.0 C
LSD	44.0	18.6	16.9

COMPOSITION OF OLIVE MILL WASTEWATER IN JORDAN

Dr. Murad Al-Maaitah

The olive and olive oil sector is key in Jordan, and over the last decades, the Jordanian industry and the production of olive oil has increased significantly due to a larger surface area of olive groves, the use of new cultivation systems (intensive and super intensive) and the use of modern methods of olive extraction.

The main problems

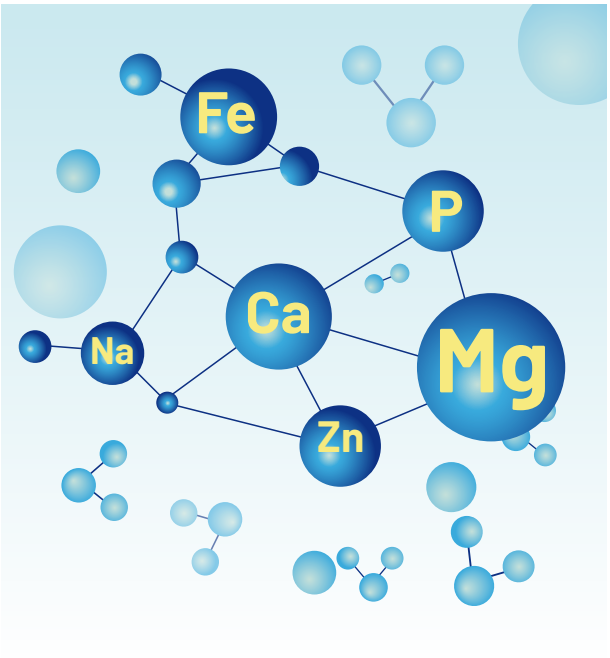
In Jordan, today, there are two main problems; the first is environmental pollution, and the second is the shortage of fresh water resources. For this reason, the main inconvenience of olive oil extraction, in addition to water consumption, is the creation of large quantities of olive mill wastewater (OMW) during the process, which generates a highly polluting effluent.

Olive mills are usually small-scale enterprises that cannot afford the costs of proper wastewater treatment unless the procedure is very simple and cheap. Most treatment technologies, however, require high investment costs and extensive technological knowledge. Thus, the most suitable solution is to build centralised treatment plants to treat OMW produced by several mills. This creates a burden in terms of operational costs, as transportation costs due to geographic scattering may be high and must be taken into account. In some cases, local conditions may call for separate treatment plants.

This effluent from the olive oil extraction process is generated in large quantities in a short period of time (i.e. it is seasonal).The effluent is generally characterised by a very high organic load, due to high levels of phenolic compounds and sugars, with minimum levels of nitrogen compounds and low pH making it one of the most serious environmental problems. It is very harmful to human health and for this reason the wastewater must be treated for disposal or reused.

Physical and chemical properties of olive-mill wastewater

The extraction and manufacture of olive oil is carried out in numerous agro-industrial units in Jordan. These generate an aqueous phase formed by the water content of the fruit combined with what was used to wash and process the olives. The combination is the so-called olive mill wastewater (OMW) and annual production is estimated at more than 160,500,000 m^3. Typically, the weight composition of OMW is 83 – 96% water, 3.5 – 15% organics, and 0.52% mineral salts. The organic fraction is composed of sugars (1.0 – 8.0%), N-compounds (0.5 – 2.4%), organic acids (0.5 – 1.5%), fats (0.02–1%) as well as phenols and pectins (1.0 – 1.5%). The maximum biological oxygen demand (BOD5) and chemical oxygen demand (COD) reach concentrations of 100 and 220 kg/m^3, respectively. As regards phenols, low-molecular weight compounds (hydroxy tyrosol, tyrosol, catechol, methyl catechol, caffeic acid) are usually present in OMW, along with catechol-melaninic polymers. Although the quantity of waste produced is still much smaller than other types of waste (i.e., domestic sewage) and its production is seasonal, the contribution of OMW to environmental pollution is important.



OMW is a mixture of vegetation, water and soft tissues of the olive fruit and the water used in the various stages of the oil extraction process, i.e. water added during malaxation and centrifugation, water from filtering disks, and from washing rooms and equipment.

The main inorganic compounds content, composition and physico-chemical status of metal cations and inorganic anions present in OMW. The following concentrations of cations and anions in these wastewaters:

*** CATIONS:**
K^+: 9.80 g/l; Mg^{2+}: 1.65 g/l; Ca^{2+}: 1.35 g/l;
Na^+: 0.162 g/l; Fe^{2+}: 0.033 g/l; Zn^{2+}: 0.0301 g/l;
Mn^{2+}: 0.0091 g/l; Cu^{2+}: 0.0098 g/l.

*** ANIONS:**
Cl^-: 1.3 g/l; H_2PO^{4-}:0.85 g/l; F^-: 0.53 g/l;
SO_4^{2-} : 0.42 g/l; NO_3^- : 0.0109 g/l.
As can be seen, K^+ was the predominant cation.

The olive mill system and wastewater

The physical and chemical properties of the OMW differ according to the operating system of the olive mill. In Jordan, three systems are used to extract the oil:

- Press (traditional) system.
- Two-outlets system.
- Three-outlets system.

The traditional press produces about 400 L of liquid waste per ton of processed olives, while the three-outlets decanting method produces about 750 L per ton of processed olives and the two-outlets decanting method produces less than 250 L per ton of olive fruits. To treat this liquid waste, an ideal treatment system for this water must be designed, and comprehensive knowledge of its composition is needed (Table1).

Table 1. Physico-chemical characterization of olive-mill wastewaters in Jordan

PARAMETER	EXTRACTION SYSTEM		
	Traditional	Three outlets	Two outlets
pH	4.4 - 6.8	4.8 - 8.6	3.5 - 6
Conductivity (mS/cm)	2 - 30.3	2.0 - 20.6	1.5 – 2.5
Humidity (%)	86 - 90	90 - 95	98 - 99
Total solids (%)	7.3 - 26.7	6.5 - 23.5	-
COD (mg O_2/L)	9100 - 246.500	31.000-200.000	4.000 - 16.000
BOD_5 (mg/L)	4750 - 100.000	5.000 - 45.000	800 - 6.000
Phenols (mg/L)	300 - 11.540	300 - 8900	44 - 1.000

During the continuous three-outlets decanter process, the addition of warm water is required at the malaxation and centrifugation stage (more than at the press extraction and two-outlets extraction system) resulting in the production of increased volumes of OMW and loss of valuable components (i.e., polyphenols) with the wastewater.

The two outlets extraction system was developed during the 1990s in an attempt to minimise the volume of waste produced and has been adopted in Jordan. The philosophy is the same as at the three-outlets centrifugation system. The difference lies in the fact that this method only generates two streams of products: olive oil and single waste, (a combination of olive husk and OMW).

Treatments of olive-mill wastewater

According to the laws and legislation of the Jordanian government (instructions of the Ministry of Agriculture), it is prohibited to release liquid waste from olive mills into the environment to avoid contamination of soil and water resources. Furthermore, these laws prohibit the dumping of this waste in municipal wastewater treatment plants, because its contents may have a toxic effect on microorganisms. In general, this water is not treated, but instead disposed of in landfills:

1. Al-Ekedar landfill.
2. Al-Humra landfill.
3. Al-Lajun landfill.
4. Jurf Al-Darawish landfill.
5. Ma'an landfill.

In all of these landfills, there are collection ponds in which these wastes are stored and disposed of during the evaporation process.

The current systems for OMW treatment can be classified as biological, physicochemical or combined processes. Among these processes, advanced oxidation processes such as electrochemical oxidation have been increasing recently.

Thus, there is no single solution to the problem, but several solutions, depending on the specific conditions of each site and the olive oil extraction method.

MANAGEMENT OF OLIVE MILL BY-PRODUCTS IN JORDAN

Dr. Salam Ayoub

Olive oil production is an important agro-industry in many Mediterranean countries. Global olive oil consumption has gradually increased over the last two decades because of the growing awareness of its health benefits, gastronomic properties and because of the population increase.

It is worth mentioning that olive cultivation in Jordan covers almost the entire Kingdom, from the highlands to the Jordan Valley and the desert. Approximately 57,000 ha are planted with olive trees, making them the country's top agricultural product. As a result, the growing area is expanding by around 5%, annually. However, the waste associated with olive oil production poses serious environmental concerns and, therefore, efficient management of olive mill waste is vital for the continuing expansion of this industry.

A positive aspect of the olive industry in Jordan is that most olive mills are of the modern continuous cycle type. There are now 139 mills in Jordan. More than 90% of these mills are new and equipped with full-automatic production lines.

Two types of waste are generated from the process of olive oil extraction; one is a solid residue called pomace (or "Jift", as it is locally named) and the other is a liquid waste called "olive mill wastewater" (OMW), known locally as Zibar. Jordan produces annually around 50,000 – 60,000 tons of olive pomace and approximately 200,000 m^3 of OMW. Most of the olive pomace produced in Jordan is used as fuel for space heating, while OMW is discharged to landfill sites without adequate treatment.Jordan produces annually around 50,000 – 60,000 tons of olive pomace and approximately 200,000 m^3 of OMW.

Most of the olive pomace produced in Jordan is used as a fuel for space heating, on the hand, OMW is discharged to landfill sites without adequate treatment.

Characteristics, treatment and utilisation of OMW

Olive mill wastewater is the liquid by-product obtained from olive fruit processing, either by traditional mechanical press or by continuous centrifugation systems. The most common extraction process yields three by-products: an oily residue, a solid residue and an aqueous residue. The latter, combined with the washing water used in the process, forms OMW. The average volume of OMW varies according to the extraction method.

Olive mill wastewater has a black or reddish black colour (due to the presence of phenolic compounds), strong offensive smell, high percentage of fats and oil, and extremely high organic load (COD and BOD5) which makes it 400 times higher than the organic load of domestic wastewater. Additionally, OMW is typically acidic (pH ~ 4-5) and has high electric conductivity (EC) range of 5.5-12 dS m^{-1}.

The OMW is characterised by acidic pH, high EC, very high concentrations of TDS, COD, BOD_5, potassium and total phenols. The unique characteristics of OMW prevent its direct discharge into domestic wastewater treatment plants. If spread on soil or disposed in "Wadis" (water streams), OMW includes many chemicals that can cause serious environmental problems.

Despite the fact that the chemical composition of OMW might cause water and soil contamination and phytotoxicity, its use in agriculture as a fertiliser has been recently promoted because of its high nutrient content, especially of its high N, P, K, Mg and Fe concentrations, as well as of its rich organic matter content.

Moreover, OMW is a readily available and inexpensive source of nutrients that could replace chemical fertilisers for crop nutrition.

It is possible to recommend applying OMW to olive orchards at 100 m^3/ha. The controlled and safe application of OMW in Jordan requires the adaptation of the local legislative status, before the method can be applied to commercial orchards.

OMW management practices in Jordan

Presently, most of the OMW in Jordan is discharged without adequate treatment, thus threatening the quality of the valuable and scarce water resources. It was reported that the minimum annual cost of environmental degradation due to the improper management of the OMW produced by the olive industry in Jordan is around 2 million USD. Most of the Jordanian environmental legislation is under construction.

A monitoring programme concerning olive mill wastewater exists. In addition, environmental regulations now restrict the discharge of olive mill wastewater into the environment. Wastewater is generally stored in concrete pools or ponds at mill sites. Eventually, it is transferred to tanks and dumped at officially designated sites. There is no OMW treatment plant operating in Jordan. It is prohibited to dispose of OMW in the sewage system because it is highly corrosive and has high suspended solids, which may cause clogging of the wastewater network in the vicinity of the olive mills.

Management of olive pomace ("Jift") in Jordan

The native name of the solid by-product of the olive mill is "Jift"; however, the terms "olive pomace" and "olive cake" are also commonly used in the literature to denote this solid by-product. Pomace usually consists of pulp bulk, olive skin, and pits, containing approximately 5-8% of residual oil.

Until very recently, only a limited amount of olive pomace was used for space heating in towns and villages of Jordan and the rest was disposed of randomly. Consequently, the improper disposal of olive pomace was a serious environmental issue in Jordan because of its negative effects on soil and ground water. Nowadays,olive pomace, with a calorific value of about 23 kJ/g, is becoming a valuable renewable energy source and an affordable substitute for liquid fuels usually used in domestic space heating. Many olive mills in Jordan press the pomace to form blocks or briquettes, and then sell these to local communities to be used for heating. Consequently, olive pomace has become a good source of income for mill owners. Olive pomace is also used in Jordan for animal feeding, to make organic fertilisers, and in composting.

In addition to using olive pomace for space heating, there are other reported potential uses of olive pomace such as fertiliser compost, a source for the manufacture of activated carbon, a source of bio-pesticides, co-firing with coal in power stations and a source of olive pomace oil for soap industry.

SENSORY PROFILE OF JORDANIAN OLIVE OIL

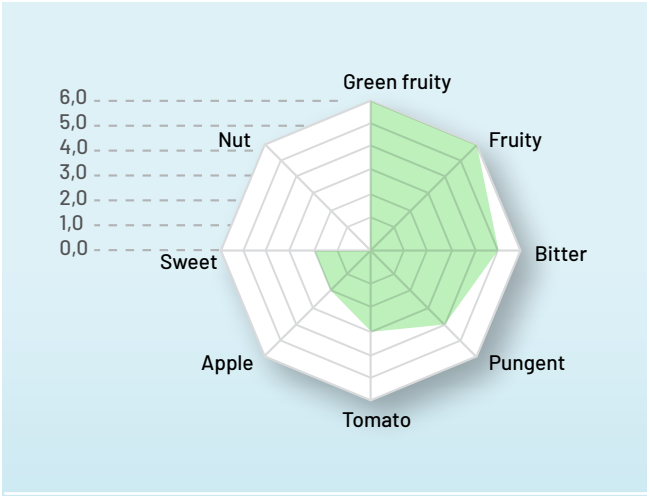
Eng. Areej Al-Hiary

The sensory specification of olive oil consists in the estimation and description of each of the properties and qualitative characteristics of the oil using the human senses, and its classification according to its characteristics.

The sensory characteristics of olive oil are affected by several factors, including the variety, environmental conditions, maturity level, the general condition of the fruits before and after picking, the method of harvesting, the method of transporting the fruits to the press, and the time period during which the fruits remain untreated after picking. There are other factors related to the level of tree care in terms of fertilising, pruning and watering, and all of these factors are reflected in the general characteristics of the oil extracted from the fruits.

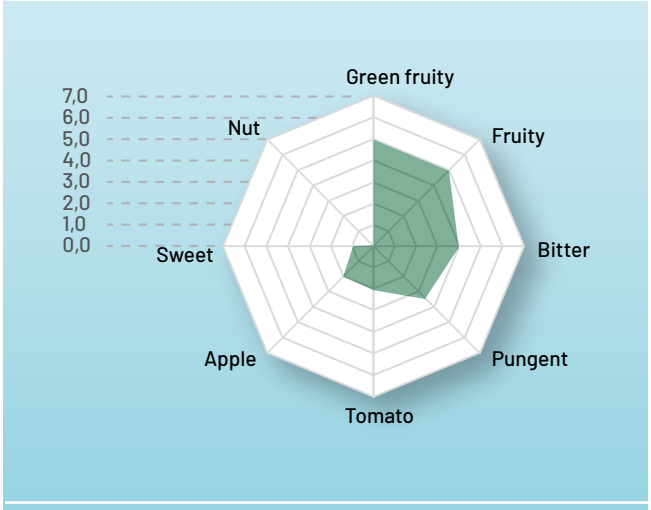
In Jordan, there is a specification for the sensory evaluation of olive oil, which is compatible with that of the International Olive Council. The purpose of this standard is to define a method for conducting the organic evaluation of virgin olive oil and to develop a method for classifying it on the basis of those characteristics. The application of this standard is limited to virgin olive oils. These oils are categorised according to the severity of their defects and as a function of their fruitiness as identified by a group of tasters who have been selected, trained and certified as a team.

The positive sensory qualities of olive oil are those that are supposed to be present in the oil if the olive fruits are harvested and treated and the resulting oil is treated in a proper manner. As for the negative traits, they may exist in olive oil as a result of incorrect practices when handling the fruits and the resulting oil.



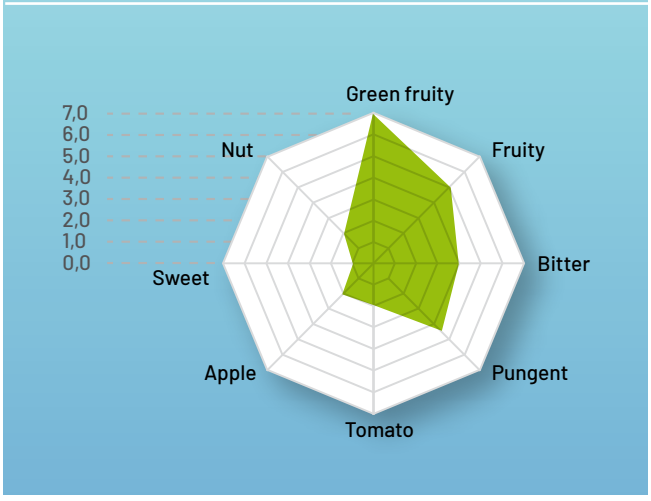
Nabali Baladi

- Considered one of the most important and most cultivated varieties in Jordan.
- It is grown under irrigation or rainfed systems, with a water need of 350 mm/year.
- Olives are usually plump with a smooth texture and have an oil content of between **25 - 33**%.
- Its fruits are used to produce oil and table olives.
- Its oil is characterised by a homogeneous texture and strong fruity bitter and pungent attributes.



Nabali Muhasen

- It is a sub-species of Nabali Baladi.
- Olives are usually plump with a smooth texture.
- Its fruits are used to produce oil and table olives.
- It contains an oil content ranging between **15-27**%.
- Strong olive varieties and rooted easily.
- It is grown under irrigation or rainfed systems, with a water need of 450 mm/year.
- Its oil is characterised by a homogeneous texture and strong fruity attributes.



Souri

- It is grown under irrigation or rainfed systems, with a water need of 400 mm/year.
- Its fruits are used to produce oil and table olives.
- It has an oil content that ranges between **20 – 28**%.
- Its oil is characterised by a homogeneous texture, strong fruity attributes and contrasting sensual qualities.

HEALTH BENEFITS OF EXTRA VIRGIN OLIVE OIL

Dr. Ahmad Mahammed Ababneh

Jordanian olive oil is typically sold as virgin olive oil for the local market while extra virgin olive oil (EVOO) is sold for both the domestic and international markets. EVOO has become a major component in diets due to its beneficial impact on human health. In general, olive oil is considered a very good source of fatty acids, specifically monounsaturated fatty acids (MUFA) and natural antioxidants. EVOO is considered the highest quality olive oil, being pure olive juice that is extracted directly from olives through mechanical or physical methods at a low temperature. It is only treated by washing, decanting, centrifugation and filtration.

Role of EVOO in health

EVOO quality and purity are governed by the strict Jordanian regulation system that can be traced from the exacting requirements applicable to the mill, through the storage and controlled production chain, in order to protect the customer from misleading information or adulteration.

This unique composition boasts high levels of fatty acids (97-99%), particularly MUFA such as oleic, plus other minor valuable components such as polyphenolic compounds, squalene, chlorophyll, α-tocopherol, and others. All EVOO components are known for their health benefits and nutritional properties, particularly relating to cardiovascular diseases (CVDs), which are very prevalent in Jordan and worldwide. The Mediterranean diet (MED) has been studied extensively, and

several studies have identified that the MED has a cardio-protective effect and health benefits, with olive oil and especially EVOO being the hallmark of this dietary pattern. Furthermore, health benefits of the MED enriched with EVOO include protection against CVD, an anti-inflammatory capacity, antioxidant properties, prevention of breast cancer, type 2 diabetes, and other chronic diseases.

EVOO and CVDs

The first demonstration of the cardio-protective abilities of the Mediterranean diet was attained in the 1950s by the Seven Country Study. This was followed by several supporting studies which looked at both the Mediterranean diet and olive oil consumption. More recently, the Prevention through Mediterranean diet (PREDIMED) study showed that a Mediterranean diet supplemented with EVOO or nuts has a protective effect on major cardiovascular events such as myocardial infarction, stroke, or even death from cardiovascular causes, with a 30% decrease of a major CVD development comparing to a control group that followed a low-fat diet.

Moreover, 10g EVOO daily are related to a reduction of up to 10% of CVD risk. In addition, some studies found that EVOO plays a critical role in reducing CVD risk factors such as central obesity, blood pressure and blood glucose.

EVOO and cancer

EVOO has a protective effect against tumoral activity, primarily as a preventative agent in breast cancer, and in general a lower incidence of cancers such as prostate, breast and colorectal has been noticed in Mediterranean countries, where the Mediterranean diet was prevalent.

The high content of antioxidant compounds in EVOO along with squalene, the primary hydrocarbon fraction in olive oil, lowers the risk of breast, skin, and colon cancer.

EVOO and neurological disease

EVOO has been proposed as a preventative tool against neurodegenerative diseases (especially Alzheimer's disease) due to its high content of antioxidant compounds that also have a protective effect against cancer and CVD. Both in vitro and in vivo studies show that EVOO is conducive to an anti-inflammatory activity, which provides a neuroprotective effect that can prevent cognitive decline and, therefore, the onset of elderly dementia or Alzheimer's disease. Among polyphenol compounds, oleocanthal (OLC) has been recently studied for its pharmacological properties, showing a preventive effect on oxidative stress, inflammation, and neurological disease.

EVOO and Arthropathy

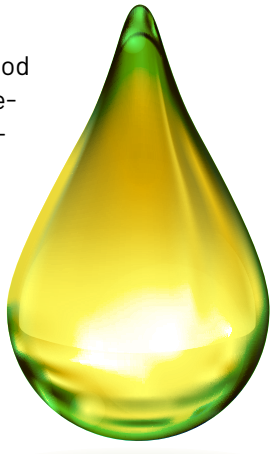
More than 30 different phenolic compounds have been identified in EVOO, with a wide range of evidence indicating that these compounds have anti-inflammatory properties. It has been reported that these properties have a positive effect on autoimmune and chronic inflammatory diseases such as rheumatoid arthritis, and cartilage diseases as osteoarthritis.

EVOO and Gut microbiota

Gut microbiota are a microbial species which lives inside the human gastrointestinal tract and is responsible for the metabolism of phenolic compounds. It has been estimated that 90-95 % of the phenolic compounds intake is not absorbed by the small intestine. This means that they remain in the large intestine, where they are subjected to gut microbiota metabolic activities. As a result, polyphenols are converted to absorbable low molecular weight compounds, and these are responsible for the health effects derived from polyphenol rich food.

The phenolic compounds in EVOO have a positive modulation effect on gut microbiota. A randomized controlled trial with 12 hypercholesterolemic participants showed that consumption of EVOO enriched with phenolic compounds favored gut bifidobacteria growth and decreased serum levels of oxidized LDL. Another systematic review of 17 RCTs found that "polyphenols exert a prebiotic action on gut microbiota, also improving prevention rates for CVD and Colorectal cancer".

EVOO is a blessing from Almighty God to human beings. Its MUFA, polyphenols, squalene and many other molecules exert functional properties that support the health and quality of life. It has been proven they contain anti-tumour, anti-cancer, anti-inflammatory, and anti-oxidant agents.



SNAPSHOT ON JORDANIAN CUISINE BASED ON OLIVE OIL

Dr. Mai Adnan Abdullah

The main products of the olive tree are the juice from its fruit – namely olive oil –, the fruit itself – which is used for table olives – and the leaves, which are used in many alternative medicine therapies.

Olive oil is an important agriproduct to complement local food and is used in cooking, pharmaceuticals, cosmetics, medicine, as fuel to light oil lamps and to produce soap. This traditional heritage product is consumed daily, as a part of the Jordanian diet, with an average consumption of 4.6 kg per year. However, some Jordanians are switching to cheaper vegetable oils for cooking due to financial reasons. Nevertheless, olive oil is still considered as a staple and the most important item for most households.

Extra virgin olive oil, EVOO, can be used as a multi-purpose cooking medium for: transferring heat from the heat source to the food, acting as a lubricant to prevent food from sticking to the cooking surface, adding or enhancing flavor, enhancing formation of a golden crust and creating a higher visual appeal for the food.

A variety of traditional Jordanian and Arabic dishes contain olive oil as an important constituent. One such example is Musakhan – an important traditional dish during olive oil production season. It consists of chicken cooked with plenty of olive oil, sumac, and onions baked on top of Arabic flatbread. Similar to Musakhan, Makmoura is another traditional dish which is characteristic of Jordanian cuisine. Makmoura consists of onions and chicken cooked in olive oil and baked with a well-kneaded dough made out of both white and whole grain flour.

In addition, fresh unheated olive oil is used regularly in salads, blended into Labneh, Hummus, Motabbal, Foul, Msabbaha, Thyme and olive oil dip, and Manakeesh among other regular dishes. A selection of traditional main and side Jordanian dishes based on olive oil are listed in Table 1.

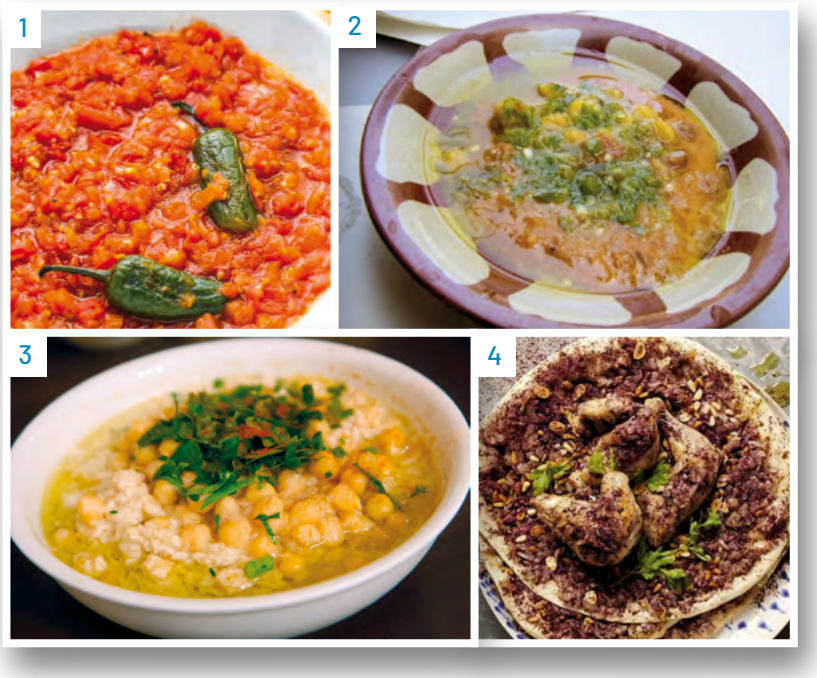
Table 1. Jordanian main and side traditional dishes based on olive oil

DISH	DESCRIPTION
GALAYET BANDOURA	Literally means tomatoes in a pan. It consists of sliced tomatoes, garlic, chili sprinkled with a mix of spices, and herbs; these are cooked with olive oil.
ARAYES	Arabic bread stuffed with ground meat, tomatoes, onions, lemon, garlic, chili sauce, brushed with olive oil and then grilled in the oven.
FALAHIYYEH SALAD	A farmer's salad consisting of tomatoes, onions, garlic, fresh uncooked olive oil and lemon.
MSABBAHA	Regular mashed and chopped hummus (chickpeas), tahini (sesame dip), spices, and lemon drizzled with uncooked olive oil.
FOUL	Dried fava beans cooked and mashed with olive oil, lemon, chili and tomatoes.
MAGALI	Vegetables fried with olive oil including zucchini, cauliflower, egg plants.
MOTABBAL	Roasted eggplant mixed with tahini (sesame dip), uncooked olive oil, and lemon juice.
YALANGEE	Green grape leaves stuffed with mixed rice, vegetables and olive oil, rolled into the shape of a finger and then cooked with lemon juice and olive oil.
MSAKHAN	Traditional Arabic taboun flatbread soaked in olive oil, topped with caramelised onions, sumac, and baked, served with roasted chicken cooked with olive oil.

A study on the "Cultural eating practices among Jordanians", conducted on a sample of 4,750 Jordanian adults (N = 4750), showed that 88.3% of Jordanians eat the Za'atar Thyme and olive oil dip daily at breakfast, and 92.8% considered olive oil as the most used vegetable oil in their cuisine.

Beside this selection of Jordanian traditional items, the Jordanian sweet and bakery sectors are both rich in dishes made with olive oil, such as Kaak, Mamoul, Zalabeya, Cake rusk, Anise rusk, and many other items.

This was a brief overview of a few select items that use olive oil as a cooking medium. It should be noted that EVOO is healthier, safer, and more stable to cook with than other common edible oils.



1. Galayet Bandoura
2. Foul
3. Msabbaha
4. Msakhan

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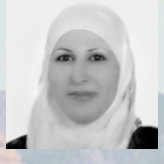

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