Fatty acids pattern of olive oil under organic Farming

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ABSTRACT

Consumers’ increasing need for safe and quality food has motivated this research study. The olive oil of the Roman olive trees (Landrace) Olea Europae belong to the Oleaceae family growing under organic farming (in the transition period) conditions in Jordan Ajln area was extracted by traditional method. The oil was analyzed for fatty acids pattern and compared with Romans trees olive oil grown at Burma Agriculture Station which has organic Certificate according to the Japanese Agriculture Standard (JAS) since 2007. The separation patterns of fatty acids were done by Gas Chromatography (GC). Results showed high levels of unsaturated fatty acids, particularly oleic acid (up to 67.49%), linoleic acid (13.31%) and linolenic acid (0.74%) in the oil of Romans trees growing in Ajln area, while the organic olive oil from the Romans olive trees growing at Burma Station showed 68.88% of oleic acid, 11.73% of linoleic acid and 0.67% of Linolenic acid. The analysis also showed that the palmitic saturated fatty acid was 12.54% at Burma Station compared to 11.82% in Ajln area. The medicinal value of unsaturated fatty acids play a great role in reducing cholesterol rate that was found in high level of Romans olive trees (landrace). Organic farming is considered as a mitigation strategy to combat the adverse effect of climate change.

Key words: Fatty acids, Jordan, olive oil, organic farming, Romans Olive (landraces) trees.

INTRODUCTION

Olive tree is the most important fruit tree grown in Jordan. It covers about 72% of the total area planted with fruit trees and 36% of the total cultivated area. Area covers now around 126,000 ha (Ministry of Agriculture, 2006). The main producing areas are; the western mountains that cross the country from north to south (rainfed) which represent about 76% of the total area planted with olive and the northern eastern region (irrigated) which represents about 24% (Ministry of Agriculture, 2006).

The major producer of olive oil in the world is the European Union (EU), which produces 80% and consumes 70% of the world’s total olive oil production (European Commission, 2010). Italy and Spain are the major producers and can influence the prices of olive oil (Blery and Sfetsiou, 2008). Greece takes third place in world production after Spain and Italy (Sandilidou and Baourakis, 2002). Olive oil is considered as a traditional food product as there are some important associations between the consumption of such traditional products and cultural aspects such as values, beliefs and life-style orientations (Vanhonacker et al., 2010). Olive oil fatty acids are the most important components in olive oil with the majority of fatty acid chains containing 16-18 carbon atoms as shown in ‘C16’ and ‘C18’ respectively (Maier, 2006). Both olives and olive oil contain substantial amounts of other compounds deemed to be anticancer agents (e.g., squalene and terpenoids) as well as the peroxidation resistant lipid oleic acid (Owen et al., 2004).

New olive oil consumers seem to be more interested in olive oil for two main reasons: health benefits and flavour (Santosa, 2010). Olive oil is claimed to be beneficial for...
health, as it is rich in vitamin E and it does not contain preservatives (Blery and Sfetsiou, 2008). Among health benefits, lowering the risk of coronary disease, preventing certain kinds of cancer and reducing inflammation have been highlighted (Medeiros and Hampton, 2007).

Nevertheless, it is true that there are other cheaper seed oils being used as substitutes (Bernabéu et al., 2009). In this respect, olive oil has a high price, although it depends on its origin and its quality (Bourdieu, 1984). For instance, virgin and extra-virgin olive oils are more expensive than standard olive oil. With regard to flavour, Santosa and Guinard (2011) Jordanian Extra Virgin Olive oils have some characteristics that distinguish it; an aroma of ripe olives with hints of apple and other mature fruits with almost total absence of bitterness (http://www.vipj.com/index.html).

According to Thompson et al. (1994), this is also a consequence of improving the taste of salads and meals. On the other hand olive farming provides an important source of employment in many rural areas of the Mediterranean, including many marginal areas where it is either a principal employer or an important part-time employer. Olive farming is also an important part of local rural culture and heritage in many areas (ec.europa.eu/environment).

Traditional intensive agriculture aimed at maximal productivity, utilizing high inputs of fertilizers and pesticides which is responsible for decline in soil fertility and adverse effects on the environment (Janvier et al., 2007). On the other hand, organic farming was proposed as an alternative for sustainable agriculture about 50 years ago and is now gaining widespread momentum for being friendly to the environment and for producing more nutritious food for human health (Sheperd et al., 2005).

Permaculture offers positive solutions to the environmental and agricultural problems. This agricultural method uses ecology as the basis of designing integrated systems of food production (Mollison et al., 1991). Organic farming works in harmony with nature rather than against it. This involves using techniques to achieve good crop yields without harming the natural environment or the people who live and work in it. Organic production essentially excludes the use of many inputs associated with modern farming, most notably synthetic pesticides and fertilizers. To the maximum extent possible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rock powders, and biological pest control. These components maintain soil productivity and tilt, supply plant nutrients, and help to control insects, weeds, and other pests. (Organic Agriculture: A Global Perspective, 2006)

**Objectives of study**

Analysis of fatty acids pattern under transition period of organic production compared with the international standard and organic olive produced in Burma certify since 2007
- Is there variation in the fatty acids pattern under organic and transition period to organic production system?
- Introduction of organic farming techniques in the rural area.
- Raising awareness and promotion of the historical (Roman) olive trees and the oil quality of these trees and to ascertain if it qualify for organic certification

**MATERIALS AND METHODS**

The olive oil of the Romans olive trees growing under organic farming (in the second year of the transition period) conditions in Ajlun area were extracted by traditional method. Water was heated up to 60°C and then seeds grounded to paste was poured into the warm water which resulted in oil layer floating on the surface of the mixture. Oil obtained was compared with the olive oil of Romans trees grown at Burma Agriculture Station in Jerash governorate (about 45km to the north of Amman) which was the target areas for the permaculture project that was implemented in the cooperation between JICA (Japan International Cooperation Agency), NICCOD (Nippon International Cooperation for Community Development) and Ministry of Agriculture in Jordan for 3 years starting from 2004. Alhashimeh in Ajlun Governorate about 70 km to the north west of Amman) 20 ha planted with old trees is the target areas for the organic production project that was implemented in cooperation with National Center for Agriculture Research and Extension (NCARE) and farmers in Ajlun/ Alhashimeh governorate about 0.5 hectare selected and applied the organic production system for about 3 years started in the year 2008. The oil was analyzed for fatty acids pattern. The pattern of fatty acids in the olive oil was analyzed using Gas chromatography (GC) machine at the Royal Scientific Association/Jordan. The analysis was done according to COI/T.20/Doc.No.24 (2001).

**Methods used**

- Awareness program through lectures, and training interested persons. Farmers in the district were contacted during the awareness program.
- Training farmers on organic farming rules and the different aspects of producing organic product so as to obtain the organic farming certificate.

Main practices used includes the following
- Water management techniques include rock basins for water harvesting.
- Soil management techniques, including compost making and mulching leading to soil conservation and fertility improvement.
Table 1. Fatty acids composition of Romans olive oil under tow farming system.

| Fatty olive oil composition | Fatty acids name | Olive oil Burma Organic certified | Olive oil Transsition period | Standard refined unit % |
|----------------------------|------------------|----------------------------------|-----------------------------|-------------------------|
| C14:0                      | myristic acid    | 0.02                             | 0.02                        | 0.0-0.05                |
| C16:0                      | palmitic acid    | 12.54                            | 11.82                       | 7.5-20.0                |
| C16:1                      | palmdollic acid  | 0.6                              | 0.57                        | 0.3-3.5                 |
| C17:0                      | heptadecanoic acid | 0.23                         | 0.30                        | 0.0-0.3                 |
| C17:1                      | heptadecenoic acid | 0.28                       | 0.33                        | 0.0-0.3                 |
| C18:0                      | stearic acid     | 3.97                             | 4.35                        | 0.5-5.0                 |
| C18:1                      | oleic acid       | 68.88                            | 67.49                       | 55.0-83.0               |
| C18:2                      | linoleic acid    | 11.73                            | 13.31                       | 3.5-21.0                |
| C18:3                      | linolenic acid   | 0.68                             | 0.74                        |                         |
| C20:0                      | arachidonic acid | 0.54                             | 0.56                        | 0.0-0.6                 |
| C20:1                      | gadollic acid    | 0.34                             | 0.32                        | 0.0-0.4                 |
| C22:0                      | behenic acid     | 0.12                             | 0.14                        | 0.0-0.2                 |
| C24:0                      | lignoeceric acid | 0.06                             | 0.05                        | 0.0-0.2                 |

- Mix planting, including green (living) mulch to prevent evaporation and soil erosion, leguminous plants to improve soil fertility and N-fixation, repellent plants as Neem tree (Nema indica), pest control using traps, and parasite system and poly-culture plantation for biodiversity.
- Creating awareness among farmers in the target area.
- Establishing a model farm (Demonstration) to implement all the Permaculture (organic farming) methods
- Improving the economic productivity of low – income farmers through:
  - Reducing the cost of production inputs by using the natural resources.
  - Introducing animal keeping activity such as chicken livestock.
  - Encouraging farmers in the target area to establish cooperative group(s) to work to reduce the cost of organic farming and upgrade the quality of organic olive oil.
  - Raising awareness and promotion of the historical (Roman) olive trees and oil quality.

RESULTS

Fatty acid compositions of the olive oil under organic farming system and in the transition period to the organic production were analyzed as presented in Table 1. The major saturated fatty acids in all oils were palmitic and stearic acids; the main unsaturated fatty acid were oleic and linoleic acid. Experiments revealed the oils tested contained large amounts of unsaturated fatty acids. The most abundant was the mono-unsaturated oleic acid (C18:1), approximately 68% in olive oil. This means that olive oil is a significant source of unsaturated fatty acid. All the studied oil samples contain oleic and linoleic acids, these oils can be classified in the oleic-linoleic acid group (Kimbunguila et al. 2010) (Table 1).

Olive oil under transition period at Ajlun Governorate showed high percentage of oleic acid (67.49%), palmitic acid (11.82%), linoleic acid (13.31) and stearic acid (4.35%) while organic olive oil at Burma Station showed oleic acid (68.88%), palmitic acid (12.54% ) , linoleic acid (11.73%), stearic acid (3.97%) (Figure 1).

DISCUSSION

Olive tree is a valuable tree; fatty acid composition of this tree in the Ajlun Governorate in the studied area showed the same composition of organic olive oil with the tree at Burama Station. Both had high percentage of unsaturated fatty acid . Oils that have high levels of monounsaturated oleic acid are considered to be of highest nutritive value (oleic acid is named after olive ‘olea’ (Maier, 2006). On the other hand, olive oil contains considerable C18:2 which is polysaturated and contributes to the instability of the oil. The International Olive Council (IOC) has produced a list of the allowable levels for each of the fatty acids to be acceptable as extra virgin olive oil, the percentage of fatty acids found by oil of Romans olive trees in Jordan, based on this study, was with allowable levels and can be considered as an extra virgin olive oil.

Owen et al. (2004) reported that olives and extra virgin olive oils contain high concentrations of phenolic antioxidants and squalene. Gulraz et al. (2009) reported that the concentration of fatty acids of wild olive were; oleic acid (69.3-74.5%), linoleic acid (1.3-3.2%), linolenic acid (11.2-15.2%) palmitoleic acid (1.10-2.10%), palmitic acid (11.2-14.0%) and stearic acid (0.1-0.2%). On the basis of the present study the fatty acid compositions of
Figure 1. Old Romans olive tree in Jordan /Ajlun Alhashmeah.

Figure 1. Analysis of Romans olive oil under different farming system.
Rumania olive oil suggested that the oleic acid concentration was the highest among the others.

**Conclusion**

Experiments revealed that the oils tested contained large amounts of unsaturated fatty acids. The most abundant was the mono-unsaturated oleic acid (C18:1), approximately 68% in olive oil under different farming system showing very little differences for both the organic and transition period. Small differences in the percent of fatty acids might be considered as geographical indicators. Jordan’s olive oil has high percentage of unsaturated fatty acids which is the recommended quality standard for olive oil and play great role in medicinal uses. Further research in studying all characteristics of the olive oil under different farming system and other varieties of olive is required.

**Recommendation**

*In situ* and *ex situ* conservation of Romans olive tree populations are powerfully recommended so as to reduce major threat of the trees like; uprooting, using of tree in landscaping, fire on the other hand etc. Implementing of simple practices that could be copied in other areas of Jordan and encouragement of farmer-based extension is suggested. With the awareness that the Romans trees have high quality oil especially in composition of monounsaturated fatty acid (oleic acid and linoleic acid) considered as quality standard for olive oil, the planting of olive trees in Jordan which is easily transferred to organic production with very good olive oil quality should be encouraged.

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