Annex I: Itinerary

8 November	Arrival Tel Aviv Airport, Jerusalem Hotel, Jerusalem
9 November	Meeting in Al-Ram PARC main Office with Mr. Ismail Daiq, PARC General Director, Mr. Saleem Abu Ghazaleh, General manager of Al-Reef Co., Mr. Mohammed Hmdat, Quality Supervisor of Al-Reef Co. and Mr. Jihad Abdou, Marketing Co-ordinator of Farmers Union. Meeting with Mr. Judeh Abdullah Jamal, PARC Deputy General Director and Director of the Arab Agronomist Association.
10 November	Seminar with groups of olive farmers in Tulkarem and in the neighbouring village of Sayda to discuss olive oil quality aspects; visit to three olive mills in the village of Sayda: discussion of quality issues with the mills operators.
11 November	Seminar with groups of olive farmers in the village of Qefeen (in the environs of Tulkarem) to discuss olive oil quality aspects; visit to two olive mills in Qefeen: discussion of quality issues with the operators of the mills.
12 November	Seminar with olive farmers in Tulkarem, a group of them representing the Organic Olive Oil Committee of the area: several issues on olive oil quality have been discussed. Travel to Jenin area: arrival in the village of Zababdi, at the PARC Training Center.
13 November	Meeting with the women co-operative of the village of Zboobah, in charge of almonds shelling; meeting with one group of almond farmers: visit to one almond orchard in Zboobah. Travel to Jerico.
14 November	Jerico: visit to the dates pack-house of Al-Reef Co.
15 November	Travel to Al Ram and meeting in the PARC main Office with Dr. Thameen Hijawi, Technical Director of the Arab Agronomist Association and co-ordinator of the PARC Project on Organic Agriculture.
16 November	Travel to Hejeh village, in the environs of Qalqelia: seminar with one group of olive farmers to discuss olive oil quality aspects; visit to one olive mill. Seminar with another group of olive farmers in the village of Bakah El-Hatab to discuss olive oil quality aspects. Travel to Nablus.
17 November	Nablus: visit to the Al-Anabtawi Factory. Village of Salfeet: visit to one olive mill. Village of Qeera: seminar with a co-operative of organic olive farmers and visit to the olive mill with which the cooperative has an agreement. Several issues on olive oil quality have been discussed.
18 November	Meeting in the PARC main Office with Dr. Thameen Hijawi, Technical Director of the Arab Agronomist Association and co-ordinator of the PARC Project on Organic Agriculture. Visit to the main Al-Reef Co. pack-house in Al Ram.
19 November	Travel to Jiftlik village (Jordan Valley) and meeting with representatives of the Palm Tree Farmers Association; visit of one palm orchard. Back to Al Ram.
20 November	Meeting in Al Ram PARC main Office with Mr. Saleem Abu Ghazaleh, General manager of Al-Reef Co., Mr. Judeh Abdullah Jamal, PARC Deputy General Director and Director of the Arab Agronomist Association, Mr. Mohammed Hmdat, Quality Supervisor of Al-Reef Co. and Mr. Jihad Abdou, Marketing Co-ordinator of Farmers Union.
21 November	Writing report.
22 November	Writing report. Seminar on organoleptic characteristics of olive oil and olive oil tasting with Mr. Saleem Abu Ghazaleh, Mr. Mohammed Hmdat, Mr. Jihad Abdou and Mr. Mubarak, work supervisor of the Al-Reef Co. main pack-house.
23 November	Travel to the Tel Aviv airport, but flight canceled due to a strike of the airport staff
24 November	Departure to Rome.

Annex II – Properties of olive oil and sensory analysis

1. The chemistry of olive oil

Olive oil is composed by two distinct classes of constituents: the so-called saponifiable fraction (98,5-99,5%) and the unsaponifiable fraction (0,5-1,5%).

The saponifiable part is made up of glycerolipids (tri-glycerids, di-glycerids, mono-glicerids), and in minor proportion, waxes and phospholipids; the unsaponifiable part, despite its low concentration, is made up of variuos components, that have an incisive impact on olive oil organoleptic characters and stability (shelf-life), as hydrocarbons, alcohols, polyphenols, tocopherols (Vitamin E), chlorophyll, carotene (Vitamin A) and others.

1.1 Glycerolipids

Fatty acids are rarely found free in cells. The major class of lipids which contain fatty acids are the glycerolipids, the most common subclass of glycerolipids found in plant oils are the tri-glycerides. A tri-glyceride is a glycerol backbone with three acyl chains attached. Fatty acids attach to the glycerol by the formation of ester bonds with the alcohol groups on the glycerol (see Figure 1). In olive oil, the three alcohol groups on the glycerol are esterified by mainly oleic acid. Tri-glycerides represent around the 97-98% of the glycerolipids of olive oil. When only 2 of the groups are esterified, we have one di-glyceride. Olive oil has small amounts of di-glycerides (2-3%). When only one of the group is esterified, we have one mono-glyceride (0.1-0.2% in olive oil).

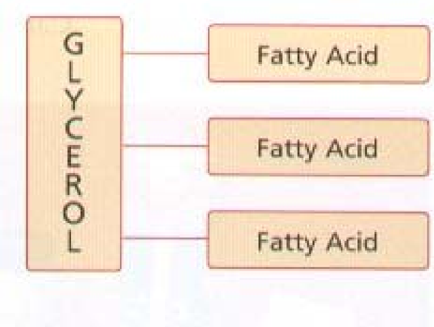

Figure 1: tri-glyceride

1.1.1 Fatty acids - FA

A fatty acid has the general formula: ***CH3(CH2)nCOOH*** where *n* is typically a number between 12 and 22. If no double bonds are present, the molecule is called a saturated fatty acid. If a chain contains double bonds, it is called an unsaturated fatty acid. A single double bond makes a monounsaturated fatty acid. Oils with more that one double bond are called polyunsaturated fatty acids (PUFAs).

In olive oil, the main fatty acids are the following:

- Oleic acid: it is monosaturated and makes up 55-85% of olive oil (C17H35COOH), also known as oleate.
- Linoleic acid: it is polyunsaturated (two double bonds) and makes up 3-21% (C17H29COOH).
- Linolenic acid: it is polyunsaturated (three double bonds), makes up 0.2-0,9%.
- Palmitic acid: it is a saturated fatty acid (C15H35COOH) and makes up 7-20%.
- Stearic acid: it is a saturated fatty acid (C17H29COOH) and makes up 5-8%.

The levels of FA (present in the shape of tri-glycerides, as stated above) vary: a) during the different maturation stages of the olive, b) with the cultivar and c) the growing pedoclimatic conditions.

The FA composition affects the freezing point of the oil. Olive oil will harden at refrigerator temperatures (around -12 °C). Water is a pure substance, so it freezes at an exact temperature. Olive oil is a complex mixture of tri-glycerides and waxes. The heavier tri-glycerides and waxes will form needle-like crystals as the temperature is lowered, then the other tri-glycerides will start to settle out. Winterization is the commercial process whereby these waxes are removed to keep the oil clearer when stored on a cold shelf. It is used mostly for aesthetics and to improve mixing when combined into mayonnaise, sauces, and dressings. Because olive oil is a natural product and different from year to year even from the same grove, each batch of oil will "freeze" at a different temperature. There is no exact freezing temperature. Freezing olive oil will not harm it; it will actually prolong it's nutritional benefits and its flavor.

1.1.2 Degradation of tri-glycerides and fatty acids

1.1.2.1 Acidity

The most important lipids alteration is the hydrolytic alteration, namely a very significant breakdown of the tri-glycerides into fatty acids: it consists of the fatty acids detachment from the molecule of glycerol (see Figure 1). Such detachment is due to the action of one specific hydrosoluble enzyme, named lipase, naturally present into the olive. Lipase may come in touch with oil in two ways:

a) when the olive is still on the tree, due to the attack of the olive fly, the larva of which digs tunnel inside the pulp, so breaking the vacuoles containing the oil and put it into touch with lipase;

b) from the harvest onward: therefore all the practices that may damage the olives during harvest and transport should be carefully avoided. Afterwards, during processing and storage, any prolonged contacts with solid sediments have to be prevented (necessity of decanting).

Moreover, lipase activity is emphasized by temperature: above all, this has to be taken into account during storage.

The hydrolitic alteration results in an increase of oil acidity. Olive oil is not water soluble so its acidity cannot be measured in pH. Fatty acids are very weak acids, when mixed with a strong base, such as lye, they will form a salt (commonly called soap). Better oils have a low acidity while lower quality oils will be more acidic. Their acid content is usually measured in percent free acidity (grams of oleic acid/100 g of oil). Extra virgin olive oil must have less than 0.8% of free fatty acids, but through a good practice of processing values of 0.3-0.4 are easy to be reached.

In summary, factors which lead to a high free fatty acidity in an oil are: fruit or olive fly infestation of fruit, delays between harvesting and extraction, especially if the fruit has been bruised or damaged during harvesting, fungal diseases in the fruit (gloesporium, macrophoma, etc.), prolonged contact between oil and vegetation water (after extraction), etc.

1.1.2.2 Auto-oxidization

As a rule, the higher the level of unsaturation, i.e. more PUFAs, the less stable is the resulting oil: this is due to the high reactivity of the double bonds of FA with the oxygen. The reaction with oxygen – promoted by heat, sunlight and the concentration of the oxygen itself – leads to the irreversible degradation of the fatty acids with peroxides formation and, subsequently, secondary compounds that give to the oil bad smells and taste (growing rancid). Various off-flavor compounds are formed by oxidation, which may be initiated in the olive fruit. Pentanal, hexanal, octanal, and nonanal are the major compounds formed in oxidized olive oil, but 2-pentenal and 2-heptenal are mainly responsible for the off-flavor.

The reaction is self-catalytic (auto-oxidization), meaning that the more peroxides are into the oil the fastest the oxidation: it proceeds slowly until all anti-oxidants are used up at which time the oil quickly becomes rancid. Sometimes an old oil will taste fine when first exposed to the air, but a few weeks later can taste old and rancid, whereas a new oil will last for months after opening.

It has to be underlined that rancidity is not a simple organoleptic defect, only: it causes a severe deterioration in the nutritional quality of the oil. Even, the high number of free radicals (peroxides) resulting from auto-oxidazation are considered toxic for human health.

The initial number of peroxides, i.e. the amount of oxygen dissolved in the oil, informs on how a certain oil is prone to be further oxidized, namely to become rancid. Optimum value of the number of peroxides at the beginning of oil life should be not higher than 5-6 meq O_2/kg: this guarantees that the oil is "young" and will keep its "youth" for many months, provided it will be properly stored.

Therefore, all the circumstances bringing the oil in touch with air, namely oxygen, have to be carefully prevented during processing, from extraction to storage to bottling.

Chlorophyll, naturally occurring in the oil, especially when leaves are processed together with olives, is a promoter of oxidization. Metals as iron, copper and manganese are catalysers of the reaction: in fact, they could come from the machineries of the mill, for this reason it is essential to use machineries/containers for storage in stainless steel only.

1.2 Anti-oxidants

Part of the unsaponifiable of the olive oil, namely the polyphenols, tocopherols (Vitamin E) and carotene (Vitamin A) are natural anti-oxidants which have been shown to have many beneficial effects on human health. They are specific of the olive and are found only in virgin oil, namely when the oil is obtained through mechanical extraction.

Anti-oxidants are also very important since they counterbalance the fatty acids oxidization (during the first three-four months of the oil life, after this time they disappear), depending on their initial concentration in the oil. However, these compounds vary with the olive cultivar, the harvest season, the pedoclimatic conditions, the age of the trees, etc.

It has to be emphasized that controlling temperature during kneading the olive paste and oil extraction is crucial to keep anti-oxidants into the oil, since excessively high temperatures of processing (> 35°C) may degrade these substances. Likewise, excessive use of water to dilute the olive paste in the automatic processing systems is likely to wash away the anti-oxidants, that are hydrosoluble. UV light may also degrade many polyphenols, therefore oil should be kept away from sunlight as much as possible.

2. Olive oil chemistry and the correlation with its organoleptic characteristics

The group of natural components going under the name of "unsaponifiable" is quite heterogeneous: in particular, aldehydes, alcohols, esters, hydrocarbons, ketones, furans, and other compounds have been identified by gas chromatographymass spectrometry in good-quality olive oil. The presence of such compounds in olive oil is closely related to its sensory quality. Olive cultivar, origin, maturity stage of fruit, storage conditions of fruit, and olive fruit processing influence the flavor components of olive oil and therefore its taste and aroma, in a such a way that it is nowadays possible to characterise a certain oil by its specific "aromatic notes": the good-quality oil may be recognised by expert tasting and distinguished among many others.

During storage of olive fruit, volatile flavor components, such as aldehydes and esters, decrease. Phenolic compounds also have a significant effect on olive oil flavor. There is a good correlation between aroma and flavor of olive oil and its polyphenol content. Hydroxytyrosol, tyrosol, caffeic acid, coumaric acid, and *p*-hydroxybenzoic acid influence mostly the sensory characteristics of olive oil. Hydroxytyrosol is present in good-quality olive oil, while tyrosol and some phenolic acids are found in olive oil of poor quality.
Therefore, all the measures allowing to keep the unsaponifiable fraction in the oil should be undertaken during post-harvest and olive processing: perhaps, this will result in lower yield, but the quality will be ensured. On the other hand, mistakes during post-harvest operations and processing are likely to result into negative organoleptic characters, that will impoverish the value of the oil.
It has to be reminded that the latest EU Regulations state that a certain oil, to be classified as “extra virgin” or “virgin”, has to pass the “Panel test” with a minimum mark (see Table 1). The Panel test is a sensory evaluation of the oil, carried out by a group of experts, officially accredited by each EU Member State. A high mark obtained by the Panel test makes the oil very valuable in the market place.

Parameters	**meas. unit**	**Extra virgin**	**Virgin**	**Lampante virgin***
Acidity	(%)	≤ 0.8	≤ 2	> 2
Nr. peroxides	Meq. O_2/kg	≤ 20	≤ 20	> 20
Panel test	Score for fruitiness	> 0	> 0	-
	Score for defects	0	≤ 2.5	> 2.5

*: not edible oil

Table 1 – Virgin olive oils characteristics (EU Reg. 1989/2003)

3. Sensory analysis: discerning between good and bad attributes

3.1 Tasting for trade classification

At the outset it is necessary to understand how virgin olive oils are defined and classified under the International Olive Oil Council's regulations. The IOOC definition of virgin olive oils has three components:

1. The oil must be extracted from sound olive fruit by only the simple mechanical processes of milling, pressing and/or centrifuging - no chemical or excessive heat extraction is allowed. By the way, the EU Regulation 1019/2002, that came into force on November 1st 2003, specifies that temperature have to be less than 27°C, in order to use words as “cold pressing” or “cold extraction” on the label.
2. The oil must meet a number of chemical tests aimed at detecting breakdown products or adulteration. The latter employ sophisticated chromatography in an attempt to maintain the distinction between virgin olive oil and the rapidly changing manipulated seed oils which can now be made to look very similar. The main tests are the measurement of free fatty acidity and the number of peroxides which measures the degree of oxidation (see above).
3. Since 1994 accredited IOOC tasting panels have been evolving a method of "Sensory (organoleptic) Assessment" which adds a subjective component to the definition of oils. Such method has been adopted by the European Union.

Tasting for trade classification is performed by the IOOC and EU accredited Tasting Panels (Panel Test) using a limited number of descriptors or indices, and these are aimed primarily at weeding out oils that have been made badly.

Best oils are also tasted with the same methodology, where a different interpretation of the attributes is used in the pursuit of excellence as the primary focus.

3.2 How an official Panel Test works

In official sensory assessment (Panel Test), the tasters (who had been screened for their ability, and who worked in a controlled laboratory setting) seek for a number of named **defects**. The most important ones and their alleged causes are:

- **Heated** or **burnt,** from excessive or prolonged heating of the paste
- **Rough,** a thick pasty sensation.
- **Vegetable water** from prolonged vegetable water contact in extraction.
- **Earthy,** from soiled unwashed olives.
- **Wormy,** from olives attacked by the olive fly.
- **Fusty,** from olives stored in piles that have undergone fermentation.
- **Musty,** from fungi and yeasts in olives stored in humid conditions.
- **Muddy sediment,** from prolonged contact with sediment in storage containers.
- **Winey - sour acid – vinegary,** due to the formation of excessive amounts of acetic acid, ethyl acetate and ethanol from fermentation in the olives.
- **Metallic,** from contact with metals during processing.
- **Rancid,** from oxidation - this is the worst defect.
- **Harsh,** is an astringent sensation perhaps due to the continuous process extraction, contact with leaves and use of metal hammer mills.
- **Pomace,** of oils extracted from the residue after pressing.
- **Pressing mat,** from unclean mats that are fermenting (traditional pressure system).

If any of these defects are perceived by the Panel, then the oil is automatically relegated to the Lampante classification (see Table 1).

The tasters then rate the oil's **positive attributes**, in just three areas:

- **Fresh olive fruitiness,** ripe or green.
- **Bitterness,** transient on the middle palate due to some greenness.
- **Pungency,** which is a biting sensation in the whole mouth and later the throat (often delayed), sometimes characteristic of olives picked early in the season.

All the the positive attributes should be present in moderation and balanced (**harmonic)**.

The Panel supervisor processes the score cards and comes up with a <u>median score</u> for defects and fruitiness attributes. The results are then used in conjunction with the acidity (and any other supportive chemical tests) to grade the virgin oil (see Table 1).

3.3 High quality extra virgin oil

While only a limited number of descriptors are used in the official sensory assessment outlined above, there is a plethora of additional attributes used to characterise the "personality"of an olive oil. The most common are:

- **Almond,** as fresh almond or dried almond which is an aftertaste associated with sweet oils of flat smell, and can be confused with rancidity.
- **Apple**.
- **Flat** or **smooth** or **weak,** from loss of or lack of aromatic compounds (see sweet).
- **Grass,** as in newly mown grass.
- **Green leaves** (bitter)**,** from excessively green olives or leaves and twigs included in the crushing.
- **Soapy**.
- **Sweet,** when the bitter, astringent and pungent attributes are weak.

3.4 How to taste

As with wine tasting, the method of tasting is individual, but usually involves:

- warm the glass to 28 °C in the cupped hands, or on a hotplate, and taking a brief initial sniff to get an immediate first impression;
- then a deeper smell to confirm, expand or negate that first impression;
- then take in a teaspoonful and roll it around the mouth cavity;
- oil in the mouth confirms or diminishes the initial smell of the **fruitiness**;
- **bitterness** is then experienced especially along the sides of the tongue;
- suck air in through your clenched teeth (stripping) and splatter the oil throughout the mouth cavity; this aspiration will enhance the fiery sensation of **pungency**;
- then you can swallow it or spit it out having noted the initial and middle palates, with the after palate sometimes quite delayed;
- finally, judge if the fruitiness, bitterness and pungency come as a nearly continuous integrated sensation without any one dominating. If so, this is a **balanced** or **harmonious** oil.

The following has to be noted:

- **Taste**. The four tastes discernible by the tongue are bitter, sweet, salt and acid. There is no sugar in olive oil and its "sweetness" is in fact absence of expected bitterness. The "acidity" of olive oil is fatty acidity, not water-soluble mineral acidity, and <u>cannot be tasted</u>.
- **Smell** (aroma)**.** The nose and pharynx detect all of the other "flavours". Taste and smell are really a combined total phenomenon. The first smell is the most important, and should detect the desirable "fruitiness" and the most common defects.
- **Common chemical sensation.** This is carried by the nerve pathways from the walls of the mouth and throat and in this situation conveys the "pungency".
- **Physical sensation.** This is the "feel" of the oil, for example," viscous".
- **Colour.** The colour tends to influence the taster's perception of the taste to follow and should therefore masked when tasting.