PROCESSING PHASE OR ASPECT		INDICATIONS OF GOOD PRACTICE AND CONSIDERATIONS ON QUALITY	OBSERVED CONSTRAINTS AND REMARKS
1) Harvest season	 Figure 1  Figure 2	- Oil quality is strongly related to the degree of ripening of the olives. There are early and late olive cultivars: each of it has its own best time for harvest (Figure 1 and 2). In general, the best time is when the olives start to change colour of the skin. - Harvesting when the major part of the fruits are overmature gives an oil with low content in protective polyphenols and poor fruitiness. In addition, the overripe olives are softer and easy to be crushed during transport: acidity and oxidization will be thus promoted.	- The more suitable harvest time for the cultivars *Nabali* and *Sorri* should be investigated (by research, field and processing trials, etc.), and harmonized with the provisions of the Ministry of Agriculture. - Are *Nabali* and *Sorri* late or early cultivars? Do they ripen in the same time, or rather gradually? etc. etc. - Anyway, my general impression is that farmers use to pick the olives at a stage when 15-20% are still green, therefore fruits are firm and not overmature.
2) Harvest techniques and transport of the olives to the mill	 Figure 3	- Olives should be hand-picked, preventing the contact with soil, and gently placed in perforated plastic boxes of 20-25 kg each (Figure 4). The use of bags shall be always avoided, since olives in bags are amassed and crushed, giving defects to the oil (see above). - Olives should immediately be carried to the mill and pressed as soon as	- Palestinian farmers pick the olives properly (Figure 3), however nobody make use of plastic boxes. Commonly, plastic or jute bags containing about 50 kg of olives are used (Figure 5). - Usually, farmers arrange appointment with the mill, but not always this system works: sometimes olives wait (still in the bags) in the mill

	 Figure 4  Figure 5  Figure 6	possible, preferably within 12 hours: to this aim, it is crucial to organise the work with the mill always by appointment. - Priority should be given to the olives infestated by olive fly (risk of "wormy" defect). - If olives have to be stored in the farm (or in the mill) for one-two days, the store place should be far from sources of bad smell (as smoke, animal dung, diesel oil, etc.); the place should be ventilated, not directly exposed to the sun and its temperature should not exceeds 25°C. Olives should not be amassed. - When storage of olives is inappropriate or prolonged, defects as fusty, musty, winey/vinegary may arise in the oil.	12-24 hours prior to be pressed. - In two mills, I saw smoke inside the room (Figure 6), coming from the burning of husk, to warm the water used in the processing. Smoke elimination from the room is very important. - In one mill, I saw a very inadequate way to store olives waiting to be processed (Figure 7).

	 Figure 7		
3) Leaves removal and washing	 Figure 8  Figure 9	- Olives should come from the field with a few leaves. - Twigs and leaves should be carefully removed, before olive pressing, since their laceration gives to the oil a bitter-harsh flavour and higher content in chloropyll (that is a pro-oxidant). This particularly applies to the processing scheme when hammer/disks crusher is used (see below). - Likewise, removing the soil from the fruit prevents the "earthy taste" in the oil, typical of dirty olives. - The mill operator should take care to frequently replace the water for washing. Dirty water, dirty olives!	- In some cases, a high proportion of leaves remained with the olives (Figure 8). - The water to wash olives in too many cases was replaced with very low frequency (Figure 9).

4) Crushing	 Figure 10	- Grindstones (Figure 10) have lower work capacity but are less aggressive than hammer/disks crushers: the resulting oil is typically harmonic and balanced. - Instead, particular attention should be paid with hammer/disks-crushers to accurately separate the leaves prior to olives crushing: the lacerated leaves could release too many polyphenols that will give to the oil a very bitter-harsh taste. In addition, the taste of pungency could become too intense.	- See above.
5) Kneading the olive paste	 Figure 11	- When grindstones are used, the operation of kneading can be rather short (15-25 min), and with a temperature of the water in the external cavity of the tank not higher than 28-30 °C. - When hammer/disks crushers are used, the oil drops are highly fragmented due to the violent action of the crusher: the oil into the paste results highly emulsified. Therefore, there is the need of kneading longer and at higher temperature to join the drops, which is not good for oil quality since the oil is quite exposed to the air (Figure 11) and	- Here there is one real critical point. All the mills I have visited apply high/very high kneading temperature. - Temperature of the warming water at around 40 °C is common; in one mill the operator reported 50 °C. Most of the times, the operators were not aware about the effect of temperature on oil quality: they told they had known about the temperature to apply from the personnel who installed the machinery. - Clearly, the aim of the farmers and the mill operators is to get the highest yield of oil, thus neglecting, on

	 Figure 12  Figure 13	heated (↑ hydrolytic alteration → acidity; ↑ oxidization → low oil stability. Possible defects of metallic, rancid and burnt). - Furthermore, high temperature of kneading degrades the polyphenolic components, thus the oil will result with very low fruitiness and weakly protected against future oxidization. - Temperature of water in the external cavity of the machinery should never exceed 35-38 °C and time of kneading not over 60-70 minutes. - For each lot of olives, the mill operator must find the appropriate time and temperature of kneading, by his experience; namely, he has to find out the best compromise between oil yield and quality. - As a general rule, the more aggressive the crushing system, the smaller the oil drops diameter, the longer and warmer the process of kneading, the higher the probability to have oil with defects.	purpose or unwittingly, the concept of quality. - The dark colour of the olive paste shows already high oxidization (Figures 11 and 13).
6) Extraction of the fluid phase (oil + water)	 Figure 14	- There are basically two technical solutions to separate the water-oil phase from the paste, each of them with advantages and disadvantages. - The **discontinuous pressure system (traditional)** (Figures 14 and 15) has the main advantage to separate the fluid	- The two mills I have visited, that are based on the **discontinuous pressure system**, were both rather dirty. Especially the cleanliness of the filtering diaphragms was very neglected (Figure 16). - The operators declared they cannot afford to renew the diaphragms

Figure 15

Figure 16

Figure 17

phase (oil + water) without heating the paste and without adding supplementary water (so-called "cold pressing"): it therefore allows to get oils rich in polyphenols, with high fruitiness and stable.

- However, such traditional system presents several critical points, mainly related to the cleaniness of the parts involved in the job:
  I. Possible fermentation and growing rancid of the paste residues that remain into the pores of the filtering diaphragms (plastic or coconut fibre mats): bacteria, moulds and yeasts are very abundant there.
  II. Prolonged contact water-oil in the container that harvests what comes out from the press.
  III. Transfer of the defects from one lot of olives to the following one.
  IV. Low work capacity (the olives wait longer in the mill prior to be pressed); high need of labour.

- To address such disadvantages it is imperative to work continuously, 24 h/24, to prevent undesired

every year: they actually replace yearly only the 30-40% of the total.

- Pressure intensity and time of pressure of the "tower" (Figure 15) were correct.
- The major part of the mills I have visited (the most up-to-date) were based on the **continuous extraction system** (also said "automatic").
- The main bottleneck I found is that the operators do not have the control of the amount of water they add to the paste; they do not know how many liters of water they add per lot of olives.
- Similarly, most of the operators do not control accurately the temperature.
- In summary, temperature and amount of added water are negligible parameters for the operators.

	 Figure 18  Figure 19	fermentations of the olive paste. - If the mill interrupts the activity, then all the parts in touch with the olive paste (above all, the filtering diaphragms) should be carefully washed by hot pressure water. - The quality of the filtering diaphragms is crucial: they should allow the complete detachment of the paste after the extraction. Furthemore, they should be replaced at the end of the season. - The proper working of the pumps placed in the harvesting containers should be frequently checked (Figure 17); the suction lift has to be complete, without residues left in the bottom of the container that could trigger fermentations. - In summary, when all the critical points are not properly addressed, the possible defects deriving from the **discontinuous pressure system** are: winey-vinegary, vegetable water, pomace, pressing mat. - **The continuous extraction system,** at 2 or 3 phases, is made up of one (or more) centrifugal extractor (horizontal decanter) that receives the paste from the mixer (Figures 18 and 19). Advantages: I. High work capacity ➔ lower	

		labour cost and less wait for the olives to be worked. II. All the mechanical parts are easily washable. Disadvantages: I. Water has to be added to the paste, to separate the fluid phase from it: as consequence, a large part of polyphenols are likely to be washed away. The water temperature should not exceeds 20-25 °C for the same reason. - In summary, the mill operator has to pay attention to the quantity of water he adds in the decanter, trying to reduce at minimum the amount with respect to the quality of the olives, and not exceeding the recommended temperature interval. - If this is not respected, the oil will have a very poor fruitiness and will be underprotected against oxidization.	
7) Final separation of the oil from the water	 Figure 20	- Vertical separators are used to divide the oil from the vegetation water (Figure 20). - It is advised against adding (hot) water to the separator: this will cause the lost of the minor components, responsible for future oil stability and aromatic flavours (fruitiness). - The container below the separator has to be daily cleaned, to remove the	- Some operators add water in the separator, to clarify the oil. - The container to collect the oil, below the separator, is often dirty.

		accumulated sediment.	
8) Oil conservation (storage, filtering, decanting, bottling)	 Figure 21  Figure 22  Figure 23	- In absence of precautions, during oil storage three negative facts could occur: I. increase of oil acidity (due to lipase activity); II. impoverishment of the aromatic notes (drop of fruitiness); III. onset of defects. Even if the amount of water remaning into the oil is in low percentage (< 0.5%), such a quantity may develop undesired defects, as the winey-vinegary and muddy sediment defects, that are due to the fermentation of various hydrosoluble substances (proteins, glucides, enzymes, etc.). - The most seriuos defect arising during oil conservation is however represented by the growing rancid: oils naturally richer in polyphenols (when freshly pressed they have bitter and pungent flavour) will present such defect later than oils poor in these components, as stated above. - Thus, suitable measures to prevent oxidization should be undertaken, as: I. to reduce to a minimum the contact between oil and air (also taking into consideration the	- Here there is another (very) critical point. - In fact, farmers and mills operators do not make use of appropriate containers for oil conservation. - The only kinds of existing containers are plastic-made and are illustrated by Figures 21, 22 and 23. - Such containers are unfit for the long term conservation of high quality oil since they are not airtight, cannot be washed well and are likely to release foreign material to the oil (chiefly the big blu ones of Figure 23). - Farmers and mill operators often use twice the same containers. - Suitable stainless steel tanks are only present in the Al-Reef Co. (PARC) pack-house, in Al-Ram, for temporary storage. - All the olive oil providers of PARC make use of such kind of plastic containers. - When PARC receives the oil from the suppliers, usually this oil had never been decanted or filtered; thus, PARC filters it, by using a tissue-filter, and puts it into the stainless steel tanks (Figure 25). - Then, in 2-3 weeks PARC

	 Figure 24  Figure 25  Figure 26	previous phases of the pressing, e.g. kneading the paste); II. to keep the oil at the optimal temperature of 12-18 °C, also using internally-cooled containers (never to exceed 22-25 °C). III. to protect the oil from sunlight; IV. to prevent metals to be in touch with the oil; V. to reduce to a minimum the contact between oil and its solid sediments and colloidal impurities. - Containers in stainless steel (300 series) have to be preferred for long-term oil conservation (at most 12-15 months). - These containers are inert; easily washable; hermetically sealed; provided with cone-shaped bottom to discharge the greasy sediments accumulating during storage (Figure 25). - Figure 24 shows stainless steel containers with low capacity, for family use. - Other materials for containers should be rejected, as: plastic, plastic reinforced by incorporated fibreglass, galvanized iron. All these materials are likely to release foreign matter to the oil. - Glass is an appropriate material, provided that it is protected from sunlight.	transfers the oil into the bottles and market it (Figures 28 and 29).

	 Figure 27  Figure 28  Figure 29	- Decanting and filtration are complementary operations. Filtration is always indispensable before bottling. - It is advised to make the first decanting after around one month, to remove most of the sediment: make sure to transfer the oil in dry and very clean stainless steel containers. - Another decanting should be carried out after 6-7 months, unless the oil is directly bottled. - In this case the oil has to be previously filtered with care, to remove all the remaining dispersed impurities, that would generate defects in the bottle, during the shelf-life. - Several filters are available: filtering materials may be represented by tissue, cardboard (Figures 26 and 27), cotton wool, etc. - The glass of the bottles should be dark (dark green or dark brown).	

General recommendations of hygiene and cleaniness	 Figure 30  Figure 31  Figure 32	- The entire line of machineries, from crusher to final separator, should work without interruption during the oil campaign. - If the plant has to stop for one day or more, the operator should carefully wash all the mechanical parts that come in touch with olives/olive paste/oil, as soon as he stops the work. - The floor and the walls of the room have to be daily washed. - It is recommended to use hot pressure water (50-60 °C), soap and caustic soda, for heavy grime. - The room of work should be isolated from any kind of sources of bad smell (husk, vegetation water, smoke, animal dung, diesel oil, etc.) (see Figure 6). - The storage room should be also kept very clean, e.g. without oil fermenting on the floor that will surely transfer bad smells to the stored oil.	- In general, in all the visited mills cleaniness of the work environment was very poor. - Dirty greasy residues were everywhere: on the machineries, on the walls, on the floor (Figures 30, 31 and 32). - The low level of cleaniness could be perceived just when entering the room. - Cleaniness and space arrangement should be improved in the PARC pack-house as well. - The operational space seems to be too cramped to effectively carry out all the operations (decanting, filtering, bottling, labelling…), so hindering to keep the work environment sufficiently clean.