

A GUIDE FOR AN OLIVE OIL PRODUCTION UNIT

1 - PRESENTATION

1-1 Nature of the Activity

Olives lend themselves to two principal forms of valorization:

- production of olives for eating : for green olives, immersion in soda, washing, pickling, and fermentation ; for black olives, treatment with soda, exposure to air, and treatment with preservatives,
- extraction of olive oil through pressing or with solvents.

Olive oil is destined for direct sale to the consumer, but also can be incorporated in industrial transformation.

1-2 Alternatives

* Finished Products :

- There exist several types of finished products, classified according to the method of extraction used (mechanical or with solvents), origin (olive oil or oil cake - expeller cake), and acidity (lower than 1 or between 1 and 3).

The most profitable olive oil on the international market is "first pressed extra virgin oil", which is extracted by pressing or centrifuging, without heat or solvents, and has an acidity of less than 1 (expressed in oleic acid equivalence).

- The oil can be sold in bulk (to be repackaged by the importer) or packaged for the consumer. Note that in certain areas, olive oil is sold in bulk to the consumer.

* Technology :

Oil extraction is a relatively simple two-step process : preparation - crushing and separation of the oil.

- Preparation-crushing : consists of smashing the pulp to allow oil extraction.
- Separation of the oil : the goal here is to separate the 3 portions resulting from the first step : the oil, the water, and the solids.

Oil is separated, then packaged.

This simple process lends itself to numerous technological options at the level of different operations:

- Laceration : before "metallic" crushing, laceration of the pulp is sometimes necessary to obtain a more homogeneous paste.
- Pitting : infrequently practiced. Only used in some units wanting to create very high quality finished products (pitting is done by laceration and trituration).
- Crushing/churning : crushing of the pulp, with or without the pit. This can be done :
 - . slowly: crusher/churner with millstone, crusher/ churner with ball which produces (after laceration) continuously a high quality oil.
 - . rapidly : metallic crushing (with hammers, discs, cylinders), followed by churning in a semi-cylindrical vat. This process allows for continuous treatment of a large volume of olives. Crushing and churning are indispensable. Rapid crushing makes the oil disperse into fine drops, which the churning regroups, ameliorating the yield of separation.
- Separation of solids/liquids : there are two ways to do this :
 - > with pressure : traditional method for both artisanal production (two passages through a scourtin press) and industrial production (vertical, screw, or band press which allow for continuous processing) ;
 - > by centrifuge : after a light fluidization (with warm water), a solid/liquid separation at high speed is possible by centrifuging.

- Separation of liquid/liquid : the liquid extracted from the paste is a mixture of oil and water which must be separated either by decanting (fermentation and oxidation risks), by centrifuging (bowl or platter centrifuges, usually with automatic cleansing), or by a mixed process (centrifuge the dregs in the vat after decanting).

The most sophisticated technologies allow for the direct separation of the 3 parts (solids, water, oil) using 3-track centrifuges with platters.

1-3 Types of Possible Units

Unit A : automated (12 t/hr). To treat all types of olives at high speed. 4 parallel lines with metallic crushers, continuous presses, solid/liquid and liquid/liquid centrifuges. Bulk packaging to supply units which package edible oil (no direct merchants).

Unit B : automated (5 t/hr). To treat high quality olives with 3-track centrifuges. Oriented towards high quality products (selection of olives, limited raw material storage). The unit sells directly oil which is packaged in bottles (the product's specificity is guaranteed).

Unit C : traditional mill with small capacity (2 t/hr) with two parallel lines for extraction with presses. Liquid/liquid separation by decanting. Packaging in tins, directly from decanting vats (after filtering). Products destined for local markets.

2 - TECHNICAL AND ECONOMIC GUIDE

2-1 Description of the Unit

2-1-1 Finished Products

LINE	A 12 t/h	B 5 t/h	C 2 t/h
Products	Virgin oil	Same as A	Same as A
Packaging	Bulk (transportation in tanks)	1 liter bottles	Tins of 5, 10 or 20 l
Production			
- daily	40 m3	15 to 20 m3	7 to 10 m3
- annual	3600 m3	1500 m3	600 m3

2-1-2 Technological Choices

OPERATIONS	TECHNOLOGICAL OPTIONS	SOLUTIONS		
		LINE A : 12 t/h	LINE B : 5 t/h	LINE C : 2 t/h
Olive preparation Storage Washing	Preliminary storage : - bulk (piles, stalls, silos, etc.) - in water Washing by spraying, immersion Possibility : a complete circuit with immersion (storage and washing)	- Storage in brine - Hydraulic transport circuit - Primary and secondary washing in closed-circuit with refuse rising in counter current - Grills to separate dirt, leaves, etc.	- Storage in rack approx. 5 cm thick - Primary washing in a bath - Secondary washing with spraying - Sorting table	- Storage in concrete silos - Washing by immersion
Paste preparation Laceration Pitting Crushing Churning	- Millstone crushing (single operation) - Metallic crushing (preceded by laceration followed by churning) - slow-speed roller-crusher (preceded by pitting)	3 parallels lines, 4 t/hr Each using : · metallic lacerater · hammer crusher · crusher churner	1 line, 5 t/hr max. Using : · 2-level lacerater, with pit expulsion · a pallet roller-churner	2 discontinuous lines, 1 t/hr each : · a mill (crusher-churner millstone)
Separation Pressing Separation Decanting Centrifuging	- "Scourtin" press, platter press or continuous press - Liquid/solid separation prepared by pre-pressing - Liquid/solid separation by decanting or centrifuging - Direct separation with 3-track centrifuge	- Regulation vat - Solid/liquid separator - Storage vat - Screw press (for oil cakes) - Liquid/liquid separator.	- Holding vat, regulation vat - Brush filter. - 3-track centrifuge separator	- Platter press. - Storage vat. - Decanting/storage vats, with drain for dreg's at the bottom
Storage Packaging Vats Packaging	Storage in vats (metal or concrete) Packaging in bottles, tins or bulk	- 35-40 vats of 10 m3. - Tank truck station	- 15-20 vats - Filtering system - Bottling 1000 l/hr	- 10-15 metal vats of 50 m3 each. - Packaging in tins

2-2 Economical Analysis

2-2-1 Investments

	OPTION A	OPTION B	OPTION C
	Price in \$ US	Price in \$ US	Price in \$ US
EQUIPMENT			
Preparation	\$ 40 000	\$ 20 000	\$ 10 000
Making of paste	\$ 130 000	\$ 80 000	\$ 60 000
Oil extraction	\$ 320 000	\$ 145 000	\$ 60 000
Oil storage	\$ 320 000	\$ 160 000	\$ 80 000
Packaging	\$ 150 000	\$ 320 000	\$ 150 000
EQUIPMENT TOTAL	\$ 960 000	\$ 725 000	\$ 360 000
Buildings	Land : 4000 m2 Building : 1000 m2 Concrete vats : 1000 m2 Vat area for finished products : 1000 m3	Land : 2000 m2 Building : 750 m2 Storage : 500 m3 (on racks) Vat area for finished products : 700 m3	Land : 1000 m2 Building : 400 m2 Storage raw material : 300 m2 Vat area for finished products : 300 m3
Other costs			
Electrical power	250 Kw	180 Kw	30 Kw
Water : for adding to and purification	60 m3/hr	25 m3/hr	10 m3/hr
Total investment	\$ 5,6 to \$ 6,5 million	\$ 2,5 to \$ 3,2 million	\$ 0,8 to \$ 1,5 million

2-2-2 Functioning

	A	B	C
Labour			
- Unskilled workers . seasonal - 3 months	8	17	28
- Skilled workers			
. permanent : director	1	1	1
accountant	1	1	1
foreman	2	1	
specialized workers	2		
. skilled seasonal workers	2	3	6
Total seasonal 1 post	10	20	34
3 x 8	27	54	90
Annual consumption			
- Electricity	500 000 Kwh	360 000 Kwh	60 000 Kwh
- Water	50 000 m3	25 000 m3	10 000 m3
- Bottles and tins		1 500 000	140 000

3 - KEY FACTORS TO THIS PROJECT'S SUCCESS

3-1 Supply

The quality of the oil depends on the quality of transportation and storage. It is indispensable to bring together growers who strive for quality :

- picking from trees (avoid ground gathering)
- pre-grouping in cases (no bulk storage in the transportation vehicles)
- rapid and frequent rotation with the treatment unit
- short term storage : at the time of storage, hydrolysis begins, causing losses, development of acidity, and temperature rise which can cause irreversible damage.

3-2 Technology and Equipment

Use and controlling of centrifuges is the most delicate point : regulating rotating speeds according to the product's quality, changing used parts, verifying equal weight distribution (recognizing that with the high speeds used, an imbalance can cause serious accidents, such as breaking the central axe).

3-3 Personnel

A trained managerial staff is necessary, to look after the delicate management of the process. Qualified workers to keep up on the sensitive equipment.

3-4 Quality Control

Each unit should have a laboratory to analyse systematically raw materials and finished products.

- analysis of raw materials :
 - . mechanic (presentation) and microbiological (yeast)
 - . useability : reaction to crushing (rheological analysis) and solvent extraction (total oil content)
- analysis of finished products : acidity, evidence of peroxide, rancidity test, and for large units, spectrophotometry with UV light, colorimetry.

3-5 Distribution and Commercialization

- Exportable oil : "first cold pressed extra virgin olive oil " packaged in bottles or for repackaging by the importer.
- Local consumption : due to habit, consumers in production zones often demand high pH oils (up to 5 %).

3-6 Financing

As with many seasonal industries, storage costs are very high :

- equipment : vats to store finished product,
- size (area) : reception basin,
- immobilization : working capital corresponds to storage value and packaging materials (bottles).

3-7 Other Specific Problems

Two principal problems : water and valorization of oil cake.

-Water :. large volume necessary for cleaning olives (varies with technology)
. used water has high oil and salt content. Purifying often indispensable.

- Expeller cake or oil cake : the solid parts do not need to be thrown away. They can be utilized in 3 ways:

- . resale to solvent-extraction industries : use of oil cake to obtain oil
- . fuel for the unit's boiler
- . raw material for animal feed.

4 - INDUCED ACTIVITIES

Sale of 18,000 tons of olives for unit A, 7,500 tons for unit B, and 3,000 tons for unit C.

Possible collaboration with animal feed units, solvent-extraction units, and packaging units.