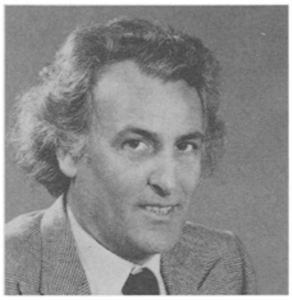
Miscellaneous Exotic Oils



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ABSTRACT

The main problems relating to olive production are described considering varieties, climatic influences and attacks by pests. Analytical data are presented on composition of fruit, oil and waste materials. A similar description is provided for rice bran, safflower, grapeseed and the oils derived from them. Olive oil quality is complicated in that three types of oil are produced: virgin olive oil, refined olive oil, and residue refined olive oil. The first is used mainly as a salad oil, the second for cooking and as a salad oil, and the third for cooking. The latter two oils also are used in preparation of canned foods (e.g., tuna, mackeral, sardine). Advantages in the use of olive oil come mainly from its composition that is very stable to autoxidation. The presence of a complex antioxidant mixture preserves the oil during storage. Problems in the production of olive oil arise from the rapid spoilage of the fruit due to its enzymatic content.

The paper is devoted to "miscellaneous exotic oils" but the right title would be "oils of past time," not because they are no longer today utilized but because some of them have been produced since recorded history. Beyong any doubt, olive oil was the first example of a fat produced by man: its trading is mentioned in the Bible.

Because of very old traditions, most of the oils I am dealing with show production problems mostly due to the changed life conditions in 5000 years.

Let's take olive for instance. Being a fruit it cannot be stored as it were a seed. It cannot be dried to preserve it. It has to be extracted as soon as possible in order to get a high quality oil. It has a kernel which gives rise to technological problems. It is poor in proteins. Problems arise, therefore, when the fruit ripens: collection and storage of the fruits, extraction capacity of the factory, manpower costs, collection and storage of the residue, solvent extraction of the residue. Because the olive is a very ancient tree, many varieties have arisen as a result of local hybridization and each variety has its own productivity, characteristics in the oil/water ratio, fatty acid composition, etc. A brief description of the present situation related to cultivation, geographic distribution is presented in Table I.

Oryza sativa, rice, is one of the oldest cereals cultivated by man. Extraction of the oil from its bran is a relatively new procedure. Problems in rice bran oil technology arise mostly from development of free fatty acids (FFA) if the bran is not processed rapidly and lipase has time to work. Rice bran oil production is depicted in Table II.

Olives have many pest problems, some of them affecting the tree and therefore its productivity, some attack the fruit itself. The olive oil fly, *Dacus o.*, is one of the most frequently encountered and sometimes due to climate conditions can cause as high as 30% production loss.

Grape seed oil is a relatively new product even if grape is one of the oldest plants utilized by man. Grape seed result is a byproduct of wine and spirit making. It is practically impossible to give figures on the production of the seed as too many variables are involved in the calculation; furthermore, most of the seed is not utilized since only limited areas, in the world, use grape seed as a source for oil.

Cartamus tinctorius, safflower, is again a very old crop, utilized in past time as a source of textile dyeing. Safflower seed production ranges from 340,000 to 380,000 metric

TABLE I

Olive Oil Production

Olea europea L.		→	Olive oil
Total area cultivated		≅	5382 ha = 13,300 acres
Number of trees		≅	500 millions
Yield/acre	260-90 lb		or 291-101 kg/ha
Geographic distribution:			
Europe	84%:		Spain 42%
			Italy 24%
			Greece 12%
			Portugal 6.6%
Asia	5.5%:		Turkey 3%
Africa	8.5%:		Tunisia 5%
America	2.0%:		Argentina 1.9%
Average composition of fruits:			
Water	50%		
Oil	22%		
Protein	1.6%		
Sugars	19.1%		
Cellulose	5.8%		
Ashes	1.5%		
Production of oil:			
1918-22[a]	711,000 tons		
1970-74[a]	1372,000 tons		

[a]Mean values.

TABLE II

Rice Bran Oil Production

Oryza sativa		→	Rice bran oil
Total area cultivated			145,000 × 1000 ha
Yield/ha			2.6 tons
Geographic distribution:			
Asia	90%		
Africa	3.3%		
Europe	1.1%		
America	5.9%		
Oceania	0.1%		
Average composition of seed:			
Kernel	52%		
Hull	20%		
Stalk	15%		
Bran	10%	→	Protein 7-12%
			Oil 9-23%
			Fiber 6.2-27%
			Ash 8-22%
Production of oil:			
Japan 1964	18,000 ton		
Japan 1979	25,000 ton		

No other data available.

tons per year.

The olive oil production process is shown in Figure 1. It is relatively complicated. The fruit after collection are brought directly to the extraction factory, where normally it is extracted within 1-3 days, otherwise acidity increases and oil quality decreases. For this reason, the extraction plants have to be oversized as all of the production has to be completed in no more than 4 months. Preparation of fruit begins with the separation of it from leaves and other foreign materials by gravity; the fruit is then washed, finely ground to a paste and sent to extraction.

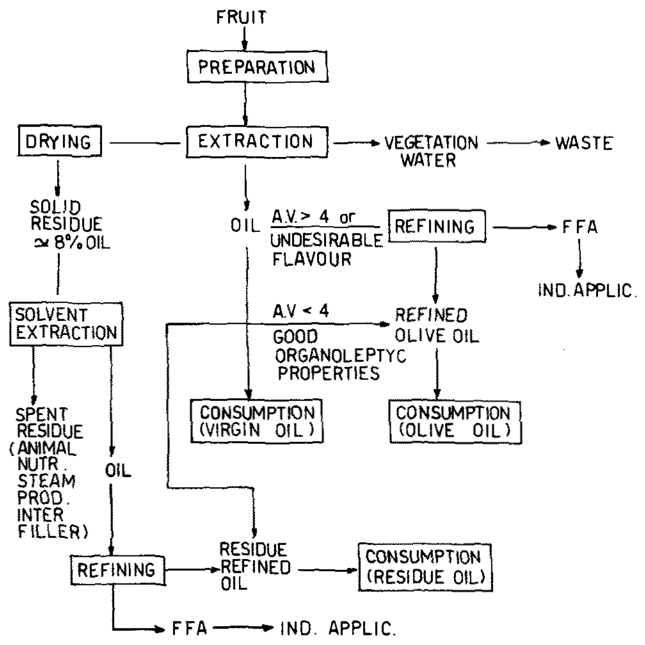

FIG. 1. Olive oil extraction and utilization.

Extraction can be carried out in several ways, but currently two main devices are used: discontinuous hydraulic presses or continuous centrifuges. The second device, because of its productivity and reduced need for manpower is displacing the presses.

Extraction gives rise to three products: oil, aqueous fraction and husks (or residue). The waste water causes many problems because its phenolic components affect the biodegradability. Husks go to a rotary drying system and to solvent extraction plant.

Solvent extraction plants are ususally not located in the same milling factory as one plant collects the husks coming from many of them. Spent husks are usually used for steam production or they are divided into pulp and kernel by gravity separators; pulp is used for animal feeding, pits for burning or as inert fillers. As a result of the whole activity, two oils are obtained. The one extracted by solvent always goes to refining. The so-called "virgin oil" obtained by pressing or centrifuging is tested for acidity and organoleptic characteristics. If the FFA is less than 4% and organoleptic character is good, the oil goes to consumption, (subdivided in various categories, according to acidity). When the FFA is higher than 4% or organoleptic characteristics are not acceptable, the oil goes to refining. All the refined oils (from husk or mechanical extraction) are blended with good quality virgin oil and go to consumption as separate products.

When neutralization of the oil is necessary, it is refined in three ways: (a) A conventional continuous centrifuge plant which does degumming, deacidification, washing. This conventional type is utilized for low acidity products under 8-9% FFA. (b) Double solvent neutralization plant when acidity is over 10% FFA. The oil is dissolved in hexane, the caustic in acetone or isopropyl alcohol in the presence of water; the two streams are mixed, the two layers separated by decanting, and each layer washed with the solvent of the other phase. The neutralized oil is then desolventized, the soaps are acidified, and the solvent distilled and fractionated. The FFA fraction goes to industrial application and the solvents are recycled. (c) The third process is based on FFA distillation. After careful degumming, usually batch type, the oil goes to a continuous bleaching plant, equipped with a recovery system of the oil by hexane extraction of the bleaching earth, then the oil goes to a physical refining unit where the FFA are distilled along with the volatile products. Usually a residual acidity (2-3%) is left and the oil is fully neutralized by conventional continuous refining plants.

Refined oil from processes (a) and (c) is then bleached in a continuous bleaching system usually equipped to extract the oil remaining in the earth, by solvent. Since olive oil is a costly product, the extraction is an economically attractive operation.

After bleaching, the oil is deodorized. Sometimes the final oil is winterized: this is always done for residual oil.

Olive oil is normally canned, more rarely bottled. Fatty acid compositions from various sources are shown in Table III.

Rice bran oil extraction can be done by three different procedures: (a) Batch type: the bran coming from the mill factory is cleaned and expressed in hydraulic presses. (b) Continuous type: the bran coming from the mill factory is cleaned, conditioned in a cooker, mechanically expressed to 6-12% oil and the residual cake extracted by solvent. (c) The so-called X-M process is an original one. The whole rice is sprayed with a minimum amount of hexane, sent to maturing bins where detachment of the bran is achieved. From the bins the product goes to the mill where, by utilization of an enriched miscella, a mechanical separation is obtained between seed and bran. The seed is desolventized and is ready for consumption. The bran is desolventized and it is utilized for edible purposes, the oil is freed from hexane and sent to refining. This process gives much more oil of far lower FFA content than the two described before; therefore the oil can be conventionally refined.

Refining problems for rice bran oil are similar (Fig. 2) to those encountered for olive oil and the solutions are similar. Sometimes rice bran oil comes from small local productions where batch type refining is used. The FA composition of rice bran oil is shown in Table IV.

Neither grape seed nor safflower seed extraction and oil refining present unusual problems and are done by conventional means. Fatty acid compositions of grape seed and safflower oils are also shown in Table IV.

Since olive oil is high in oleic acid and contains many phenolic components, it is very stable autoxidation even in deep frying. Rice bran oil is relatively high in oleic and linolenic acid; grape seed and safflower oils are among the oils highest in linoleic acid.

Olive oil production in the future is strictly dependent on a decrease in cost of production and an increase in the value of byproducts. I see many more opportunities for improvements in these areas than in extraction or refining technology which is mostly up to date.

Similar considerations must be applied to rice bran oil, taking into account that a technology exists to solve

TABLE III

Variations in Fatty Acid Compositions of Olive Oil

	Italy[a]	Tunisia[a]	Israel[a]	Portugal[a]	Turkey[a]
16:0	7 - 17	18.3	12.0	12.1	11.1
18:0	1.5 - 4	2.5	4.0	2.5	2.5
20:0	0 - 0.7	0.5	0.4	0.4	0.4
22:0	0 - 0.3	–	–	0.1	0.1
24:0	0 - 0.5	–	–	0.4	0.4
Sat.	8.5 - 22.5	21.3	16.4	15.8	14.4
16:1	0.3 - 3	2.4	0.4	1.5	0.7
18:1	63 - 83	56.4	72.0	75.3	74.1
20:1	0 - 0.5	0.5	0.1	–	0.2
Mono.	63.3-86.5	59.3	72.5	76.8	75.0
18:2	5 - 13.5	18.9	10.0	6.1	9.4
18:3	0 - 1.5	0.8	0.5	1.0	0.2
Poly.	5 - 15	19.7	10.5	7.1	9.6

[a]Mean values.

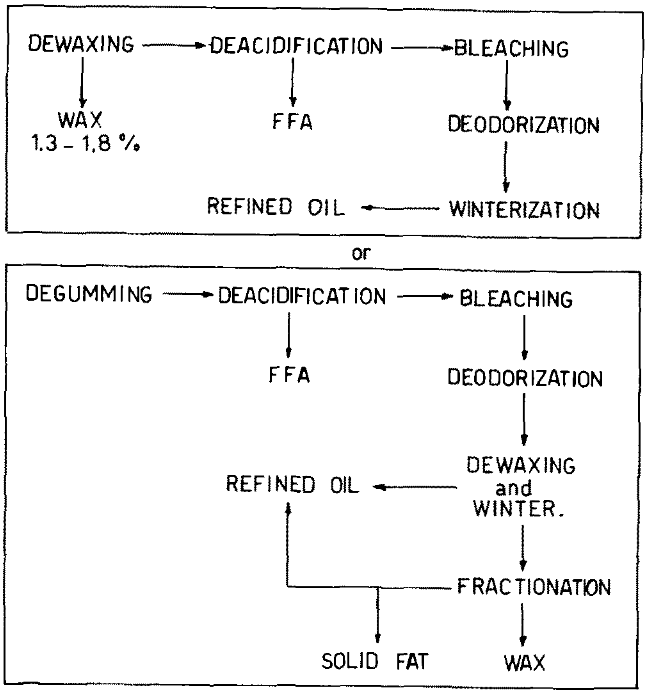

FIG. 2. Refining of rice bran oil.

TABLE IV

Fatty Acid Compositions (%)

FA	Rice bran oil	Grape seed oil	Safflower oil
14:0	0.1 - 1.0	0 - 0.2	0 - 0.4
16:0	12 - 18	6 - 8	4.1 - 5.1
18:0	1 - 3	3 - 6	5.4 - 6.5
20:0	0 - 1	0 - 0.5	0.5 - 1.0
16:1	0.2 - 0.6	0 - 1	trace
18:1	40 - 50	12 - 25	7.1 - 7.5
18:2	20 - 42	60 - 76	78 - 80
18:3	0 - 1	0 - 0.5	0 - 0.1

many of the production problems normally encountered only in small productions.

Grape seed oil production could increase sharply because of the potential seed that is available at the present and not used. Grape seed oil, like rice bran oil, comes as a byproduct from other more important processes. Safflower oil could have a better future because of its linoleic acid content but in general the future will be bound to the competition with the kings of today's production: soybean, sunflower and rapeseed.