



# HANDBOOK OF OLIVE OIL

Analysis and Properties

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John Harwood  
Ramón Aparicio



AN ASPEN PUBLICATION

# **Handbook of Olive Oil**

## **Analysis and Properties**

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**AN ASPEN PUBLICATION®**

Aspen Publishers, Inc.  
Gaithersburg, Maryland  
2000

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**Library of Congress Cataloging-in-Publication Data**

Handbook of olive oil : analysis and properties / editors, John Harwood, Ramón Aparicio.

p. cm.

Includes bibliographical references and index.

ISBN 0-8342-1633-7

I. Olive oil—Analysis. I. Harwood, John L. II. Aparicio, Ramón.

TP683.H36 1999

641.3'463—dc21 99-36143

CIP

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Member of the worldwide Wolters Kluwer group.

Editorial Services: Denise Hawkins Coursey

Library of Congress Catalog Card Number: 99-36143

ISBN: 0-8342-1633-7

Printed in the United States of America

1 2 3 4 5

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# Preface

Olive oil is the major edible vegetable oil of the Mediterranean countries and Portugal. It is also, perhaps, the oldest reported crop in history. The olive tree is capable of existing in a harsh climate on poor soils, and trees 500 years old still bear fruit. The oil itself is much prized for its flavor and aroma. The highest-quality oils are obtained, without solvent extraction, from fresh and healthy fruits. Although the subtle sensory characteristics of olive oil account for its popularity, despite a high market price, increasing interest has been given to its nutritional properties, which are believed to play a large role in the so-called "Mediterranean Diet."

In this book, we provide a wealth of detail about the analysis and properties of olives and their oil. After an introduction to olive oil and to technological aspects, we include a section on biochemistry because, of course, the unique properties of the oil are based on the biochemistry of the olive fruit. This applies not only to the main constituents—the various triacylglycerols—but also to minor sensory components that are derived largely from the lipoxygenase catabolic pathway. Following are chapters that deal with the analysis of olive oil from the standpoint of general methodology, and later chapters describe detailed techniques.

The sophisticated analytical methods have to be evaluated by the use of mathematical procedures for characterization. A description of such applications is followed by extension of the methods to evaluate sensory quality, the role of different components in these attributes, and authentication procedures. The book closes with comments on the role of lipids in human nutrition and some of these aspects as applied to olive oil.

We have endeavored, by the recruitment of appropriate world experts, to ensure that the book is authoritative and up to date. The importance of edible vegetable oils throughout the world is predicted to increase steadily, and olive oil is no exception. Moreover, with the increasing perception by developed nations of the high quality of olive oil, as well as its nutritional desirability, there undoubtedly will be more interest in its analysis. We hope that this book will prove to have widespread utility for such analyses and will contribute to a popular appreciation of the unique properties of olive oil.

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# CHAPTER 1

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## Introduction

*Fausto Luchetti*

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- 1.2 Geographic Distribution of World Production of Olive Oils
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- 1.4 International Trade in Olive Oils
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- 1.8 Scientific Research To Determine the Nutritional Assets of Olive Oil

### 1.1 WORLD ECONOMIC IMPORTANCE OF OLIVE OILS

At first glance, olive oils seem to be of limited importance when viewed in terms of world statistics. This applies to both production and consumption. On comparison with other edible vegetable oils that are potential substitutes, olive oils account for 3 percent\* of human consumption and are clearly outstripped by soybean oil (27 percent), palm oil (20 percent), rapeseed oil (15 percent), and

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\*All the statistics in this introduction are from the database of the International Olive Oil Council, which is compiled from the figures regularly supplied by its member countries. When necessary, these are supplemented by statistics printed in publications of international organizations, such as, the Food and Agriculture Organization of the United Nations, or specialist magazines, such as *Oil World*.

**Table 1–1** Share of Olive Oils in International Trade in Edible Vegetable Oils, Excluding Intra–European Community Trade

<i>Oils</i>	<i>Share of Volume (%)</i>	<i>Share of Value (%)</i>
Palm	45	30
Soybean	19	19
Sunflower	11	12
Rapeseed	8	9
Lauric	11	9
Olive	2	15
Corn	2	3
Other fluid edible oils	3	3
Total	100	100

sunflower oil (12 percent). Their share is on a par with corn oil. The same occurs in international trade where olive oils represent no more than about 2 percent of the volume of edible vegetable oils sold.

In terms of product value, however, olive oils have a distinctly larger (15 percent) share of world trade because their unit market value is significantly higher than that of other alternative oils. In fact, it can be two, three, or even four times higher, depending on the country, category of oil, and year. Olive oils account on average,\* for a large percentage of the agricultural exports of some countries such as Tunisia (38 percent). In the case of Spain and Italy, this figure is 5.5 percent and 4.4 percent, respectively. Table 1–1 shows the share of olive oils in the world trade of edible vegetable oils.

Consequently, though it varies from one country to the next, the economic importance of olive oils grows considerably when one looks at the economies of certain regions of the world. In fact, it becomes crucial in the Mediterranean countries. Besides its deep roots in history and civilization, the olive oil sector makes a notable contribution to the economic activity of several countries. In Spain, for instance, over half a million farmers are involved in olive growing, and the sector annually provides 46 million working days. In Tunisia, more than one tenth of the population earns all or part of its income from olive farming. Also, in Tunisia, the sector provides around 30 percent of seasonal employment in agriculture, in addition to the permanent jobs. Table 1–2 shows the relative importance of this sector in this part of the world.

The economic and resultant social importance of the olive oil sector in Mediterranean countries is clear from its ranking in terms of gross agricultural domestic product and from the employment and wealth it generates. Also, for

\*Period 1990/91–1996/97

**Table 1–2** Importance of the Olive Oil Sector in the Mediterranean Countries

Country	Share of GADP <sup>1</sup> (%)	Share of Area under	
		Agriculture (%)	Arboriculture (%)
Spain	10	11	49
Italy	5	10	41
Greece	15	21	66
Portugal	NA	14	57
Tunisia	14	33	83
Syria	17	8	63
Turkey	NA	3	29
Morocco	3	5	68
Algeria	NA	3	36
Jordan	15	20	88

Note: NA, not available.

<sup>1</sup>Gross agricultural domestic product.

countries such as Tunisia, olive oil is not just a commodity. It is a positive strategic product, so much so that Tunisia has made it an export product by granting subsidies to encourage home consumption of other substitute vegetable oils.

## 1.2 GEOGRAPHIC DISTRIBUTION OF WORLD PRODUCTION OF OLIVE OILS

Olive oil production is heavily concentrated in the Mediterranean countries, which have 99 percent of acreage and produce 98 percent of the world's olive oil (Table 1–3). The European Community (EC) is the leading player and accounts for about 75 percent of world production. Within the EC, Spain, Italy, and Greece alone supply more than 97 percent of EC production. Olive acreage in the EC, and more particularly in the above group of three countries, however, represents no more than 52 percent and 47 percent, respectively, of the total world acreage. This shows that the levels of yields in this region are generally higher than elsewhere. Next in line are Tunisia and Turkey, which have 19 percent and 10 percent of acreage, respectively, but account for only 9 percent and about 5 percent of production, respectively.

Within these countries, olive growing is also quite localized. For example, 60 percent of Spain's olive orchards are located in Andalusia, where 75 percent of Spanish olive oil is produced. Italy is in the same position with 63 percent of both its acreage and production centered in the southern regions (e.g., Apulia, Calabria). In Tunisia, too, 60 percent of the olive orchards are in the central part of the country, which contributes 30 percent of production. In contrast, the south has only one fourth of the country's olive orchards but produces more than half its olive oil.

**Table 1–3** Geographic Distribution of World Olive Oil Production

<i>Country</i>	<i>Area</i> <sup>1</sup>		<i>Production</i> <sup>2</sup>	
	<i>Hectares</i>	<i>Percentage</i>	<i>Average</i> <sup>3</sup>	<i>Percentage</i>
European Community:	4506.85	51.73	1425.2	74.4
Spain	2227.00	25.56	602.2	31.4
Italy	1141.35	13.10	451.3	31.4
Greece	718.50	8.24	332.0	17.3
Portugal	400.00	4.59	37.4	2.0
France	20.00	0.23	2.3	0.1
Other European countries	75.16	0.86	7.0	0.4
Tunisia	1624.00	18.64	172.9	9.0
Turkey	881.00	10.11	92.0	4.8
Morocco	450.00	5.17	46.3	2.4
Syria	421.50	4.84	81.0	4.2
Algeria	206.28	2.37	29.0	1.5
Argentina	40.00	0.46	9.1	0.5
United States	15.80	0.18	1.4	0.1
Others	490.52	5.63	52.1	2.7
Mediterranean countries	8606.18	98.80	1873.9	97.65
Total	8711.11	100.00	1916.0	100.0

<sup>1</sup>1,000 hectares<sup>2</sup>1,000 tonnes<sup>3</sup>Average for the period 1990/91–1996/97.

This heavy concentration of olive farming in certain regions is explained by the climatic conditions required for the olive to fruit, as well as by the fact that this tree offers an almost unique opportunity to make maximum use of water and soil resources that, as a rule, are simultaneously limited in several arid regions of the world.

### 1.3 GEOGRAPHIC DISTRIBUTION OF CONSUMPTION OF OLIVE OILS

Like world production, consumption of olive oils is also practically concentrated in the producing regions; 71 percent is centered in the EC, and 92 percent of this figure corresponds to the three leading countries, Italy, Spain, and Greece. Table 1–4 gives the geographic breakdown of olive oil consumption, itemized by country. It is striking to see the small consumption share of olive oil in the oil consumption of some producing and exporting countries, such as Tunisia and Turkey. Clearly, this is a direct consequence of their domestic economic policies, which are aimed at encouraging olive oil exports.



**Table 1–4** Average Olive Oil Consumption (in Thousands of Tons) for the Period 1990/91–1996/97

<i>Country</i>	<i>Consumption</i>	<i>Share of World Consumption (%)</i>
European Community:		
Italy	645.3	31.6
Spain	476.0	23.3
Greece	201.3	9.8
Portugal	51.5	2.5
France	42.9	2.1
Others	40.1	2.0
Total European Community	1457.1	71.3
United States	115.7	5.7
Syria	82.1	4.0
Turkey	65.7	3.2
Tunisia	54.4	2.7
Morocco	44.7	2.2
Algeria	25.9	1.2
Other countries	199.3	9.7
<b>World Total</b>	<b>2045.0</b>	<b>100.0</b>

When expressed in per capita terms, the same producer countries are also the leading olive oil consumers. It is noteworthy, however, that the annual consumption of the average Greek is almost the same as that of the average Spaniard and Italian taken together. Table 1–5 lists the six countries where annual per capita consumption is above two kilograms.

Although no more than 3 percent of the vegetable oils consumed in the world are olive oils, this share rises to 30 percent in the primary olive oil–producing

**Table 1–5** Average Annual Per Capita Consumption of Olive Oil for the Period 1990/91–1996/97

<i>Country</i>	<i>Per Capita Consumption (kg)</i>
Greece	19.5
Spain	12.1
Italy	11.2
Tunisia	7.9
Syria	6.1
Portugal	5.2