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The IOC sets sail for the Americas

When we look back in years to come, 2011 will stand out as the year when the IOC set its sights on new horizons in new continents, first and foremost the Americas.

To begin with, 2011 has seen the launch of an 18-month, EUR1.2 million campaign to boost consumption of olive oil and olives in the United States and Canada by positioning olive oil as the cooking oil of choice and giving table olives a prominent place in the North American diet. So, after a long lull, the IOC has returned to what was its first major target market back in 1983/84. The member countries and the industry at large pin great hopes on this food- and health-focused campaign led under the slogan of "Add Some Life" in two important markets for exporters.

Besides being a major importer of olive oil, the USA is also becoming a force to be contended with as the home olive oil industry starts to take off, in California particularly. At the other end of the continent too, olive growing is gathering pace in countries like Argentina, Chile and Peru which are moving onto front stage while incipient industries are getting off the ground in other South and Central American countries such as Brazil, Mexico or Uruguay.

The picture is one of a continent with much to offer for both production and consumption of olive products, from California to Catamarca, and where the newcomers to olive growing are bubbling with new ideas and new technology.

"…a continent with much to offer for both production and consumption of olive products, from California to Catamarca…"

Argentina is a recent, proactive addition to the IOC club. Since joining, it has taken a keen interest in IOC affairs and it has made a constructive contribution to discussions, bringing with it new ideas and new perspectives. At the IOC's recent 17th extraordinary session in Istanbul, very kindly hosted by the Turkish authorities, the Argentine delegation announced that Argentina wishes to host one of the IOC's sessions in 2012. This signals the importance it attaches to the IOC as a unique intergovernmental/industry meeting point for settling olive growing issues and for forging a true community spirit amongst the world's producers.

At the IOC we hope to see our community expand with other new Members from elsewhere in the continent, for instance Argentina's next door neighbours Brazil and Uruguay. Both have attended IOC sessions recently as observers, both have dynamic, newly fledged olive associations and both have recently expressed interest in joining. This comes at a time when the IOC will be gearing up for a major promotion campaign in Brazil on the heels of ongoing market research.

The Executive Secretariat is working elsewhere too as part of this concerted effort to attract other countries from the northern and southern hemispheres to join its ranks as members or observers. As part of this drive, it met in July with senior members of the United States Department of Agriculture in Washington to cement working relations and to involve the USA more actively in IOC activities. Although not in favour of membership as yet, the US authorities are considering the possibility of applying for observer status. This would be yet another welcome addition in approximating positions on many issues of concern and interest to the olive industry.

The Executive Secretariat is also periodically in contact with the authorities and stakeholders in countries like Chile and Peru, two thriving olive producers that have shown interest in IOC activities. Interestingly, to give an indication of how new producers are flexing their muscles, Chile intends to spend USD 1.8 million on promoting Chilean olive oil in the United States.

In its infancy, the Mediterranean was the cradle of olive growing, but now in its adulthood, it is becoming a truly multicultural industry present in numerous countries across the globe. This makes it all the more important to join forces in an international non-profit organisation like the IOC whose foremost aim is to work neutrally for the benefit of olive growing through its drive for quality, product authenticity and fair, clean trading. There's room on board for everybody!

Jean-Louis Barjol
Executive Director

Interview with José Manuel Silva, the European Commission's Director-General for Agriculture and Rural Development

After a five-year stint at the head of the Directorate-General for Research of the European Commission in Brussels, José Manuel Silva returns to the helm of the agriculture directorate general of this EU institution, which he headed from 1999 until 2005. Born in the Galician region of Spain but European in spirit, he returns to this post at a crucial point for European agriculture with the latest reform of the Common Agricultural Policy (CAP). We invited him to answer some questions about the olive sector and the long-standing relationship between the EU and the IOC.

Q1: The European Union is the biggest contributor to the IOC budget. What are the benefits of IOC membership for the EU?

A1: The EU is part of the large community of olive and olive oil producers. Olive growing has played a significant role in the development and history of the Mediterranean countries, and continues to do so. Nowadays olive oil enjoys a very positive image in terms of its health-related properties and gastronomic attributes.

Although the EU is the leading player in the world olive industry, we believe that the common interests of the olive producing countries in a world market are best defended through the IOC (of which the EU is a Member), which is an international organisation under UN auspices.

The main benefits of IOC membership for all the Members are the harmonisation of national and international legislation, the establishment of standards, the generic promotion of olive oil and table olives, the provision of technical cooperation and the expansion of trade.

Q2: What are the advantages of EU participation for the other Members of the IOC, primarily from the Arab world and more recently from South America?

A2: Irrespective of whether or not they belong to the IOC, all the olive growing countries have a shared interest in keeping alive the positive image of olive products and in contributing to the development of a common, harmonised product policy.

The member countries of the IOC together account for virtually the whole of world production. Although the EU alone holds 70% of the participation shares, it favours consensus-based solutions in keeping with the provisions of the 2005 Agreement.

The IOC is the authoritative world forum for discussing new scientific developments, particularly in olive oil chemistry.

The activities carried out by the IOC such as technical cooperation, training and promotion build on and strengthen the links between the Members.

Q3: What moves do you consider essential to strengthen collaboration even further between the IOC and its Members?

A3: The strength of an international organisation lies in the dynamism of its membership and in the fruitful exchange of ideas at its sessions or committee and expert group meetings. The EU takes an active part in discussions and is very ready to listen to proposals framed by the other partners. Cooperation between the IOC and its Members could be strengthened by all the Members taking a proactive approach and contributing innovative ideas.

Q4: How will the latest CAP reforms affect the olive sector in Europe as well as in the other olive growing

countries inside and outside the IOC?

A4: The EU olive sector already underwent extensive reform in 2004 and the single payment system is completely decoupled from the type of production. The broad goals of the new 'Post-2013' reform are viable food production, sustainable management of natural resources and climate action and balanced territorial development.

In the current context where producers are faced with more growing pressure on their incomes in a generally difficult economic period, provision will have to be made for 'horizontal' instruments to ensure better risk management, to respond to crises and to stabilise income while ensuring compatibility with the WTO green box. It will also be necessary to support the producers who practise environment and climate friendly farming.

The new 'Post-2013' reform is expected to contribute to the harmonious development of the EU olive sector. It should not affect the olive sector in the other producing countries.

Q5: As olive growing expands and new producing countries come onto the scene, what role can or should promotion play in stimulating a balance between supply and demand for olive oil and table olives?

A5: In recent years, supply has been mounting without interruption in all countries through a combination of improved crop production techniques and new orchard plantings. Consumption has been rising too thanks to the health-promoting attributes of olive oil and its culinary reputation.

Consumption needs to be stimulated to ensure market equilibrium, and here promotion has proved to be an effective tool. The IOC and EU successfully set off down this pathway years ago.

In an ever more competitive world market, we believe that promotion plays a key part not only in upholding the quality and image recognition of olive products, but also in raising consumption.

Q6: How does the EU ensure compliance with IOC standards in international trading by its Member States?

A6: Like all the Members who have signed the 2005 Agreement, the EU has pledged to take whatever measures are appropriate to facilitate trade and encourage the consumption of olive oil and table olives.

However, in a constantly shifting international context, it is observed that IOC standards differ from Codex Alimentarius standards while some importer countries are at the same time developing their own standards.

The EU and IOC have worked out a joint position on standards, both vis-à-vis the Codex Alimentarius and the standards or testing methods taken into account by some importing countries.

Q7: How do you see the role of the IOC in the future? What direction do you think it should take to consolidate its position as the authority on everything to do with the olive?

A7: Our vision is for the IOC to be the world point of reference on all things to do with olive growing.

To achieve this, it is desirable for:

- As many producing countries as possible from around the world to become Members
- Scientific developments in olive oil chemistry to be taken on board for swift, permanent updating of standards
- IOC standards to be even more authoritative in international trade
- Generic promotion and technical cooperation to remain key IOC activities
- The IOC to become a neutral, objective observatory on pricing, market parameters, trading and production costs on world olive oil markets. ■

The Executive Director out and about

In the age of high-technology and the cyber world, the human factor is still very important in building the visibility and credibility of any organisation. As the year has moved on, Jean-Louis Barjol has continued with his rounds of contacts, travelling far afield from Athens to Shanghai, from Tunis to Perugia. Here are just three examples of this networking.

IMPERIA, ITALY, MAY 2011

With the Liguria Riviera as backdrop, the first part of the two-stage Mediterranean Diet Forum kicked off on 6 May. Focused on the Mediterranean Diet following its declaration by UNESCO as an intangible cultural asset, the forum was organised by the Imperia Chamber of Commerce in partnership with the *Associazione Nazionale Città dell'Olio,* the Liguria regional authorities, the provincial and municipal authorities of Imperia and UNESCO. The IOC was one of the sponsors through its grant funding scheme.

The forum was an assembly point for representatives from the olive growing countries – many of them IOC Members – as well as from olive and olive oil associations and federations across the Mediterranean, ministries, research centres and the media. It was an ideal, single location for Barjol to talk with a large number of people in separate events and on the sidelines. Nine working groups were also created to draft papers for presentation at the second part of the Forum, scheduled for 18–19 November 2011. The discussion points will cover many aspects of the Mediterranean Diet as a legacy, a tool for marketing or food education, or a way of preserving landscapes, traditions and knowledge for future generations. There will also be papers on the role of extra virgin olive oil as a staple of the Mediterranean diet, the landscape of olive orchards and the Mediterranean Diet and health.

Group photograph of Mediterranean Diet Forum participants.

The second day of the forum was largely dedicated to the creation of the EuroMediterranean Olive Oil Towns Network. All the countries present signed a Protocol of Agreement pledging to pursue the shared aims of strengthening the image of olive oil producing areas, establishing olive oil documentation centres and museums, consolidating a network of contacts and common activities, encouraging olive oil research and learning, and conserving and recapturing the flavours and aromas of the traditional Mediterranean Diet. The Executive Director signed the protocol as a mark of the IOC's strong support for this initiative.

The plans for the second stage of the forum are to present the papers on the Mediterranean Diet topics as well as to put forward a Mediterranean dietary model and to launch the proposed nomination of the Mediterranean Olive Landscape as UNESCO-recognised intangible cultural heritage.

IZMIR, TURKEY, JUNE 2011

While on a four-day visit to Izmir just ahead of the IOC session in Istanbul, the Executive Director met with senior members of the National Olive and Olive Oil Council of Turkey. Known by its Turkish acronym, UZZK is one of the leading organisations driving the development of olive growing in Turkey and the production of premium quality product.

UZZK had lined up a number of meetings for the Executive Director, including a press conference with print, Internet and audiovisual journalists which generated significant coverage for the IOC in Turkey. Barjol also met with the management of TARIS, a major Turkish player in the international and domestic marketing of olive oil, olives and soap – the visit was also reported in the local press – and he toured the olive nurseries and varietal collection of the Bornova-Izmir Olive Research Institute, a new partner in the RESGEN project.

Accompanied by the UZZK President and the Head of the IOC Promotion Unit, Barjol took part in a 30-minute programme recorded for Aegean TV. The broadcast went on the airwaves on Wednesday 29 June. In it the guests focused on the role of the IOC, the importance of Turkey's return to the Organisation and IOC cooperation with UZZK.

While in Izmir, Mr Barjol also took part in the ceremony awarding certificates of attendance to the thirty or so participants in an organoleptic assessment training course held as part of the IOC technical assistance programme and led by Professor Moreda from the Seville Fats & Oils Institute.

The tasting course trainees show off their certificates.

WASHINGTON, UNITED STATES, JULY 2011

July saw the Executive Director in the United States for a hectic round of appointments, meetings and visits between the 6th and the 11th. The trip came at an important turning point in IOC activity with the start of its promotion campaign in North America.

It began with an informative meeting with eight representatives of the United States Department of Agriculture (USDA). The subjects on the table were the position of the IOC as the official world organisation for olive oil and olives, US/IOC relations and future opportunities for closer collaboration, especially on technical and scientific issues. The USDA team explained that while the US authorities were not in favour of IOC membership, they were exploring the possibility of observer status.

Barjol attended the annual meeting of the North American Olive Oil Association, an important partner in the IOC's quality control scheme, where he listened to the opinions and concerns of people at the heart of the US olive oil import and distribution business.

Next stop: the National Association for the Speciality Food Trade (NASFT) Fancy Food Show. Over three days, the Executive Director spoke to over 40 olive oil and table olive exhibitors (from Albania, Argentina, Chile, Cyprus, Egypt, France, Greece, Italy, Morocco, Palestine, South Africa, Spain, Tunisia, Turkey and the USA) besides meeting with top-ranking members of the Italian, Greek, Moroccan, Spanish and Tunisian authorities and being interviewed by three journalists.

The announcement of the IOC's 'Add Some Life' promotion campaign in North America was made during the Show and released to the participant media.

The Executive Director also had face-to-face meetings with US olive oil producers and Chilean business operators. During their talks, the main points that emerged were the concern about the fight against fraud and compliance with official rules and regulations. ■

Istanbul rendezvous for the IOC's 17th extraordinary session

When meeting in Madrid for its 98th regular session between 22 and 26 November 2010, the IOC Council of Members received an invitation from the Turkish delegation to hold the next extraordinary session in Turkey. This kind invitation was unanimously accepted.

Istanbul was therefore the rendezvous for the 17th extraordinary session, hosted by the Ministry of Industry and Foreign Trade and several Turkish olive oil and table olive producer associations at the Grand Cevahir Hotel from 27 June to 1 July. Through the session the producer associations laid on a display of their products – olive oils, table olives, olive oil-based specialities, cosmetics,… – next door to the conference room.

The week began with the meeting of the IOC's Advisory Committee on Olive Oil and Table Olives where industry representatives from the member countries (producer, exporter/importer and consumer organisations) were joined by observers and delegation members. The IOC Executive Secretariat invited a team to attend from Exponent, the US public relations agency chosen to conduct the IOC's planned 18-month campaign to promote olive oil and olives in North America. After giving an overview of the agency, Exponent gave a detailed rundown of the strategy and activity format for the campaign. Feedback was invited from participants who were able to ask questions and make suggestions.

Overview of the conference room.

The Executive Secretariat reported on the world market for olive oil and table olives and announced upcoming market research on olive and olive oil consumption in South Korea, Australia and Japan. The outcome will be made available to the Members and will be analysed in close detail at the next committee meeting.

A year earlier at the 15th extraordinary session of the IOC in Essaouira, Morocco, the first talks were delivered in a series of PPT presentations on olive and olive oil consumer profiles. In Istanbul, the focus of the profiles was on consumers in Syria, Greece, Turkey and Portugal. These presentations go down well with the committee members because they are a source of up-to-the-minute information on the habits of olive oil and table olive consumers in a spectrum of markets.

The next meeting assembled the associations that have signed the quality control agreement monitoring the olive oils and olive-pomace oils sold on import markets. Fifteen associations (from Europe, the United States, Australia, India, Japan, Brazil, Turkey and Uruguay) currently participate in this scheme, aimed at giving assurances that ex-

JL Barjol thanks the Turkish authorities and associations for their hospitality.

ported oils are correctly defined and named, that their physico–chemical characteristics are true to grade and that they comply with IOC labelling criteria. The association members who were present were invited by the Executive Secretariat to sit in as observers at the meetings of the Technical, Economic and Promotion Committees.

At the end of the first day of meetings, the Advisory Committee hosted a buffet reception featuring specialities from Turkish cuisine. After guests had enjoyed their meal the Executive Director thanked the authorities and associations for their warm welcome and presided over the award of prizes for the Turkish National Olive and Olive Oil Council's (UZZK) quality programme.

Discussions continued the next day in the Economic Committee meeting. World conditions on the olive oil and table olive markets were reviewed in detail and committee members discussed farm gate prices and the impact of currency aspects on the market.

The Promotion Committee met in the afternoon. Members listened to the progress report on the olive and olive oil promotion campaigns in China and Russia besides discussing the upcoming campaign in the United States and Canada and the market research in Brazil. The Executive Secretariat announced future market research in Australia, South Korea and Japan. When the 2012 programme was presented, participants discussed ways of making media tours more dynamic, setting up a Best Article competition for olive-related stories and future plans for *Olivæ*. All the committee members congratulated the Executive Secretariat on its work.

Later that evening, the Turkish authorities took all the participants on a cruise of the Bosphorus for a delightful dinner with beautiful cityscape views.

At its meeting the next day the Technical Committee congratulated the Executive Secretariat on the ground covered in olive oil chemistry and standards-related work, training and technical assistance, and research and development and environmental issues. Topics included the specialist glossary posted on the IOC website in the five official languages of the Organisation, the new procedures for the selection of scholarship awardees, chemistry work and the IOC Mario Solinas Quality Award.

Participants boarding for the dinner cruise.

Participants touring the table olive processing facility in Bursa.

The last specialist committee – the Financial Committee – met in the afternoon to approve the financial statements and audit report for 2010.

After a field trip to Bursa for a tour of a table olive processing plant and an olive oil processing facility, participants returned to Istanbul for a fine dinner of Turkish dishes at a city centre restaurant.

The next day the Heads of Delegation held a restricted meeting to discuss some internal management issues prior to the plenary session on the Friday when the committee reports were presented by their chairpersons and approved by the Members.

Participants applauded the smooth proceedings. All the Heads of Delegation took the floor to say a personal and official thank-you to the host associations for their generosity and the seamless arrangements through the week. Before proceedings drew to a close, the Head of the Argentine Delegation conveyed his government's invitation to host one of the IOC sessions in 2012. This offer met with enthusiastic acceptance from the member countries' delegations. ■

IOC Master's degree scholarships: making a difference for the future

Since the Master in Olive Growing and Olive Oil Technology first got underway at the University of Córdoba in 1995, the International Olive Council has sponsored 57 students from 13 IOC Members through this post-graduate degree programme. No mean feat for a small organisation like the IOC. But behind every figure there's a personal story too.

Luckily for the IOC and its scholarship scheme, the world has moved on from the days when Oscar Wilde defined 'the most exquisite art of idleness' as one of the most important things that any university can teach. Since 1995, the IOC has been a partner in the Master programme in olive growing and olive oil technology set up at Spain's prestigious University of Córdoba (see Q&A interview with the Director of the Master) comprising lectures, laboratory and field work in the first year, followed by research and the submission of a thesis at the end of the second year.

The university in Córdoba has seen a long string of students from all over the world pass through its lecture rooms in a bid to become highly qualified specialists in olive cultivation, olives and olive oil. When Sofiene Hammami arrived in 2005 with an IOC grant, the first things that struck him were the modern facilities and the helpful attitude of the lecturers and administrative staff. Just qualified as an agronomist from the University of Carthage in Tunisia, he quickly slipped into the routine familiar to any postgraduate student. Classes in the morning, lunch at home, sometimes with friends, a bit of television to practise his Spanish, and then back to his desk for some hard study. And of course some relaxation in the evening, out with friends.

Sofiene defended his thesis in 2007. The theme was the utility of vegetative and growth habit parameters in the selection of new varieties of olive. "This subject interested me because it's original. And also because I think that moving forward in the selection of new cultivars adapted to modern olive growing is one of the most promising ways of making this crop profitable and sustainable in the future," he said when asked about this choice.

He defines his time on the Master course as a 'very enriching' experience, both on a professional and personal level. "The courses and practicals were given by the best specialists in the industry and gave me top quality training in olive cultivation and olive oil technology. On a personal note, it was deeply satisfying to get to know Spain and Spanish culture and to make friends with people of more than 12 different nationalities."

When this issue goes to press, the Croatian IOC scholarship awardee Tatjana Klepo will have just defended her thesis on the utility of wild germplasm in an olive breeding programme. Although the olive is not the predominant crop in Croatia, her vocation for olive growing goes back to her infancy when she had a fascination for olive orchards and the country's ancient wild olive trees. Besides her Master, she's also doing her PhD at the Adriatic Crops & Karst Reclamation Institute on the subject of the national genetic identification of cultivated and wild olives.

It didn't take long for Tatjana to settle in at Córdoba. Like Sofiene, she has warm words for all the staff who helped her to feel at home straight away. In her mind, educationally speaking, the first year of the Master has equipped her "to work at any stage of olive growing and the olive oil industry". In the second, research-oriented year, she learned a lot about genetics, with the focus on olive growing, as well as about planning and organising trials, drafting scientific papers, doing statistical analyses, … "I'll definitely be able to benefit from all of this in future jobs."

On a more personal level, Tatjana sums up her experience by saying: "My stay in Spain for over two years has

been an experience I'll never forget. It's been enriching professionally, personally and culturally, and it's given me the chance to mix with people of other nationalities. That teaches you a lot about getting on with others on a day-to-day basis". And, like Sofiene, she's now a fluent Spanish speaker into the bargain.

Two people – one female, one male – from two different countries who share the same interest in olive cultivation and the same positive experience of the IOC scholarship programme.

"The IOC scholarship programme is helping to train top-quality specialists in olive growing and olive oil technology with international experience. In turn, this gives the developing olive producing countries the opportunity to develop olive growing at home and make it sustainable," said Sofiene when queried about what the programme has to offer the olive growing world. Tatjana's answer when asked the same question was, "All the countries in the world, especially the lesser developed nations, need skilled, specialised staff... The IOC scholarship programme can do a lot to make this come about. Education is the first, most important step to achieve the technological and scientific objectives for the development of olive growing".

Like everything in life, there's always room for improvement and the scholarship scheme is no exception. Although personally very pleased with the IOC scheme, Tatjana suggests "increasing the number of scholarships awarded to each country, especially for countries where olive growing is young". Sofiene suggests "offering PhD scholarships to the best Master students to allow them to continue studying and to train researchers for the development of the sector".

Both have clear ideas about the priorities for the future: education, reorganisation, modernisation and the drive to find new varieties to make olive growing quality-focused and sustainable.

One of the best gauges of the success of education is to see whether students actually put into practice what they've learnt. Sofiene has already participated in various research projects and he has scientific articles and communications to his credit, and he's stayed on in Córdoba to write his PhD thesis. When he finishes, he intends to go back home. Through research, he wants to do his bit to help develop olive growing in Tunisia and to give it more international competitive edge.

As for Tatjana, she intends to apply her knowledge and expertise to build up close working ties between research centres in Spain and Croatia through joint projects. Also, working directly and indirectly with olive growers and businesses in Croatia, she means to try to promote the transformation of traditional olive groves into modern olive orchards by applying everything she learned in Córdoba.

These are just two of the success stories which prove that IOC scholarships can make a difference through the combination of a leading university and bright students keen to build a better future for olive growing.

Because it believes so firmly in the key role of educating specialists for the future, the IOC entered into a sister partnership with the University of Perugia in Italy in 2003 for a similar postgraduate programme. The upshot so far: 25 scholarships awarded to students from 10 IOC Members. But that's another story we'll have in store for readers. ■

About IOC scholarships

Amount: 860 euros/month for board and lodging, plus
Return travel expenses once per academic year
Medical insurance
Matriculation fees

Applications must be submitted through the Head of Delegation of the IOC member country to which the applicant belongs

More information at www.internationaloliveoil.org

Five Q&A interview with the Director of Córdoba university's Master in Olive Growing and Olive Oil Technology

Professor Ricardo Fernández Escobar currently holds the Chair in Plant Production at the University of Córdoba (ETSIAM), a job he combines with other posts, including the directorship of the university's international Master in Olive Growing and Olive Oil Technology since the year 2000. Equipped with a long career in university teaching, he has extensive experience to his name in the world of research comprising participation in 42 research projects, 66 publications in technical or scientific journals, 55 congress papers, 5 books and 11 monographic works. He has also supervised more than 44 research studies. This great scientist who has cooperated with the IOC on numerous occasions has kindly replied to a brief question-and-answer interview about the Master and the IOC scholarship scheme.

View of university installations.

Q: How has the Master gradually evolved since it was first set up?

A: The Master has been taught since 1995 under an agreement signed by the organising institutions (University of Córdoba, Department of Agriculture and Fisheries of the Regional Government of Andalusia, Andalusian Institute for Research and Training in Agriculture, Fisheries, Food and Organic Production, the International Olive Council, the International Centre for Advanced Mediterranean Agronomic Studies and the National Institute of Agricultural and Food Research and Technology). In 2007 it became an official Master's degree in the Spanish university system following changes in university syllabuses to adapt to the Bologna Plan.

The underlying criteria of the academic structure of the Master have remained unchanged since its outset: a taught specialisation course in the first year and a research study in the second year under the supervision of a prestigious PhD-holding tutor serving as the basis for the submission of a Master thesis. The end result is the right kind of training to enable the Master graduates to work in production and to start out in research.

Throughout its history, the Master has gradually adapted to the academic demands imposed by the progress in subject expertise and the interests of students who answer regular surveys along with faculty members and collaborators. As a result, syllabus content has gradually been moulded to these criteria. With teaching input from professionals and experts from the collaborating institutions and the private sector, students come out with top-flight training in olive growing and olive oil technology.

Thanks to these achievements, interest in studying for the Master has blossomed. From the 70–80 applications received in the

first intakes, the number of applications has swelled to over 140 in the latest intakes. Students are coming from further afield too, chiefly from the American and Mediterranean regions. In all, students from 22 countries have passed through the programme.

After eight intakes, the research done by students to write their thesis and earn their Master's degree has generated significant advances in the knowledge in these subject areas. Many of the research studies have been published in scientific journals, congresses, workshops, etc. All of this makes the Master not just a teaching exercise but a programme that helps to add to the knowledge about olive growing and olive oil technology with the active involvement of the students. In short, students do not merely study: they play a part in expanding the boundaries of knowledge while they are being educated.

Q: What do you think the IOC scholarship awardees have got out of the Master and vice versa?

A: Besides adding to the students' knowledge over the two years, the Master has opened up employment opportunities for all of them. According to surveys of the graduates, the course is highly rated and has sometimes been decisive in helping them to find a job. But it has also given them something else that is hard to find elsewhere: a teaching team ready to help them resolve any doubts when their course of study is over. This allows them to carry out projects, particularly in the early stages, in the secure knowledge that they can rely on the advice of an expert who knows them and who will help them out with any problems. It also gives them a chance to get to know fellow students from other countries with whom they tend to build lasting bonds.

The IOC gives its scholarship awardees the unique opportunity to access these achievements while the awardees bring a valuable mix of nationalities to the group of students.

Q: Do you think that scholarship programmes like the IOC programme can really help to improve the olive industry in the member countries?

A: Clearly, they can. The combination of top-level training, continuing contacts with the teaching faculty and the lasting relations with fellow students from other countries creates a propitious background to apply their acquired know-how in their home countries. This is a proven fact.

Q: How would you describe the collaboration with the IOC?

A: The IOC is one of the institutions that take the keenest interest in the Master. The increase in the number of scholarships for the current intake, the start of a PhD scholarship scheme in olive growing and olive oil technology and the IOC's clear and compelling willingness to support these courses of study make it an essential player in their development.

Q: What do you have in prospect for the Master?

A: The Master is feeling the brunt of the economic crisis too in that the contributions of some institutions have decreased considerably due to financial constraints. This has made it necessary to restructure the high cost of the Master to make it continue to be viable in this period of crisis. Fortunately, we have been able to do this without detracting from the quality of the education on offer with the help of the teaching faculty who are committed to keeping up high standards. Coupled with the interest in joining the programme, the positive rating that graduates get from the olive sector and the commitment of the organising institutions, this augurs a very optimistic future for the Master. ■

The RESGEN project: 16 years down the road

Biodiversity has become a buzz word in the policies of governments and international agencies alike as concern grows over nature conservation in general and the irreparable loss of species. In the case of the olive, there is a serious risk of genetic erosion with the growing tendency to use an ever shrinking number of varieties. Through the RESGEN project the IOC has been trying to do its bit to conserve existing olive varieties and to establish the genetic heritage of each country's native olive resources.

The objectives of the International Olive Oil and Table Olive Agreement include encouraging research and development and preserving olive gene sources. These two aims are pursued in parallel in one of the IOC's major scientific projects, which has recently been amplified to take on board three new project partners.

The longest running of the IOC's technical projects, and one of the first to be put into effect, the RESGEN project has been in progress for some 16 years. First designed as a combined European Union and International Olive Council initiative to collect, characterise and conserve the genetic biodiversity of the olive, the project later continued on two tiers as a project executed with financing from the Common Fund for Commodities (CFC) and a stand-alone IOC project. In short, the same project has been implemented over the years under three separate top hats: IOC/EU (France, Greece, Italy, Portugal and Spain); IOC/CFC (Algeria, Egypt, Morocco, Syria and Tunisia) and the IOC on its own (Croatia, Cyprus, Iran, Israel, Jordan, Lebanon and Slovenia).

The overriding aims are to preserve the world's wealth of genetic olive resources in national and international repositories, to conduct surveying to recover lost or unidentified germplasm and to tap this genetic heritage, especially to help improve olive and olive oil quality, to make olive growing sustainable by ensuring that the varieties grown are suited to their surrounding conditions, to convert it into a tool for combating erosion and desertification, and to stem the population drain from rural areas.

All in all, the output is quite impressive. Seventeen national collections have been set up in the 17 participant countries so far, plus numerous core collections, and two world collections based in Córdoba, Spain, and Marrakech, Morocco, house certified specimens from the national collections while a third collection is in the pipeline (see inset).

Established 30 years ago at the Alameda del Obispo Centre of the Agricultural, Fishery, Food and Organic Farming Research & Training Institute (Spanish acronym, IFAPA) in Córdoba long before the RESGEN project took off, the World Olive Germplasm Bank was the first collection to house the accessions generated by the project. An international reference marker in the world of olive research and varietal performance evaluation, it is involved in numerous projects aimed at preserving the legacy of the olive and making sure these precious resources are not lost. At present, this collection has 425 varieties from 21 countries.

The second world olive collection was custom-built for the RESGEN project. The 17-hectare collection opened in March 2002 after the IOC and the Moroccan agriculture ministry signed an agreement to house the accessions shipped by the project participants at the experimental station of the National Agronomic Research Institute at Tassaout, near Marrakech. To date, it houses 489 accessions from 14 countries.

Uniform methodologies have been devised and applied for the primary characterisation of olive varieties, based on 32 morphological characters related to the tree, leaf, inflorescence, fruit and endocarp, and their subsequent secondary characterisation to

View of the Marrakech collection.

determine their agronomic, phenological, pomological and oil quality traits. A large database has been built up recording the 1091 accessions recovered and characterised under the RESGEN project so far. Along the way, the project has helped to clarify many mistaken varietal denominations, to build up a network of working ties between the participant institutions and to provide the scientific community with reliable, tried-and-tested varietal information. And now, the Executive Secretariat is setting the project in motion in the three latest additions to the IOC membership – Albania, Argentina and Turkey.

After a coordination meeting in Madrid, the project is to get off the ground to investigate the genetic variability of the species *Olea europaea* in these three new partner countries over a period of two years. Interestingly, it will be the first time that the RESGEN project will be crossing the Atlantic to the southern hemisphere where the National Institute of Agricultural & Livestock Technology has been appointed as the collaborating centre. Back in the Mediterranean, the Vlora-based Agricultural Centre for Technology Transfer will be the project partner in Albania and the Bornova-Izmir Olive Research Institute in Turkey.

As the membership base of the IOC expands, the RESGEN project is gradually spanning the bulk of varietal resources in olive. Hopefully, with time it will encompass the world's entire resources. Looking ahead to the future, prospective plans are to take characterisation one step further via the application of molecular markers. Much still remains to be done to map and save the genetic makeup of the world's olive varieties in line with the Rio convention on biological diversity. But one thing is certain: diversity is essential for the long-term viability of olive growing. ■

Five contenders for the third world olive collection

The rationale for the installation of a third world olive collection is to conserve olive biodiversity in an additional repository as an insurance policy against potential incidents at the other two collections (bad weather, fire, pest attacks).

The collection will ensure that this diversity is conserved for future generations and will set up a "test bank" where scientific work will be carried out to gain a deeper insight into this important genetic material.

Five countries – Egypt, Jordan, Iran, Syria and Turkey – have responded to the IOC's call for proposals to establish the third world collection. All are from the Eastern Mediterranean, the natural location for this third collection owing to the importance of olive growing in the region.

Winners take home prizes for the IOC *Mario Solinas* Quality Award 2011

As announced in our previous issue, members of the diplomatic corps, guest organisations and media professionals converged on the IOC headquarters on 17 June for the award of the prizes to the winners of the IOC *Mario Solinas* Quality Award 2011 selected from amongst the 97 extra virgin olive oils entered for the competition from France, Greece, Israel, Italy, Morocco, Portugal, Spain and Turkey.

The prize winners received their gold, silver or bronze medal and diploma from the hands of the Executive Director and the Financial Delegate of the IOC. Finalists also went home with a diploma in acknowledgement of their endeavours to produce top quality oils.

As a token of thanks for their disinterested collaboration, diplomas also went to the twelve **IOC-recognised tasting panels** that selected the finalists as well as to the international panel of judges faced with the difficult job of proposing the winners.

After the ceremony, the IOC hosted a reception for attendees who had the chance to savour the organoleptic characteristics of the winning oils and to see for themselves why they deserved their accolade.

The ceremony and the details of the winners and finalists were reported at length on the IOC website.

As usual, watch the IOC website (www.internationaloliveoil.org) from December onwards for the rules of the next competition – the 12th so far – open to extra virgin olive oils from the 2011/12 season.

OLIVE OIL TASTING: A LEARNING EXPERIENCE

Ahead of the prize giving, the Executive Secretariat arranged an introductory course on the sensory analysis of virgin olive oils for representatives of the Embassies of the IOC member countries and members of the specialist press.

The course featuring theory and hands-on tasting was given by the Head of the IOC Technical Unit, Mercedes Fernández Albaladejo. After running through some introductory theory and necessary basic concepts, Ms Fernández put the attendees through their paces as she showed them how to taste the winning and other extra virgin olive oils and she explained their characteristics.

At the end, each participant received a certificate of attendance from the Executive Secretariat. ■

Line-up of the Award prize winners.

Silver jubilee coming up for the IOC organoleptic assessment method

Lately, the IOC's method for the organoleptic assessment of virgin olive oils has been very much in the news. One of the quality criteria specified in the IOC trade standard, the method has been called into question in some quarters but there can be no doubt about one thing: its adoption caused a 'revolution' in the regulatory world of virgin olive oils. The development of the method was not fortuitous. Quite to the contrary, it was the end result of much time and effort invested by all those pioneers of the sensory analysis of virgin olive oils who offered their expertise to the International Olive Council.

The application of sensory analysis to olive oil dates back to work carried out in the 1970s by the team of Rafael Gutiérrez from the Seville Fats & Oils Institute. At the beginning of the 1980s, the IOC teamed up with nine experts from six countries (Spain, France, Greece, Italy, Portugal and Turkey) to draw up a method modelled on internationally recognised standards and methods for the objective evaluation of clearly defined smell and taste characteristics for the different grades of virgin olive oils.

The first method was adopted in 1987. Thanks to the efforts of the late Mario Solinas, a leading authority in this subject field, and of the leaders of European panels, the European Community incorporated the organoleptic assessment of virgin olive oil into its regulations in 1991.

The standardisation of the application of sensory analysis to olive oil is therefore 24 years old and has come a long way since then. It has taken much hard work to enable virgin olive oil to benefit from the advances in sensory testing science. With background support from mathematics and statistics, from being purely subjective and hedonistic it has become an objective quality criterion listed in international standards (IOC, of course, and Codex Alimentarius) as an essential quality criterion for the classification of virgin olive oil into each of its categories.

One cannot speak about the sensory analysis of virgin olive oil without mentioning and saying a big thank-you to the nine pioneers who did so much to bring it about. Regrettably, some of them are no longer with us, but others have continued with unflagging dynamism. Over the years much criticism has been levelled at the method by processors and packers and it has been an arduous task defending it from those who called it into question and often tried to bring about its demise.

Ten years after it was first adopted, the method was extensively reworked in 1996. Now it incorporated more statistics and tasters had to behave as mere instruments, measuring the intensity of any defects and a few positive attributes (fruitiness, bitterness and pungency). This method remained in force until it was revised in November 2007. A more recent revision followed in November 2010.

In tandem, the interest in sensory analysis and particularly in the organoleptic appraisal of olive oil has never ceased to grow amongst experts and the public at large.

The long standing efforts of the first pioneers have paid off: industry uses this tool for measuring sensory quality as an instrument for improving quality and consumers learn to recognise sensory quality. A clear example of this surge of interest is the international extra virgin olive oil competition the IOC has been holding since the year 2000 (in 2012 it will be celebrating its twelfth year) and the competitions organised by other institutions in a number of countries. This is a clear signal that organoleptic quality is a crucial testing parameter and one that is irreplaceable nowadays in appraising quality.

In the 1980s the nine pioneering experts set up a core of 'historical' taste panels. Since then, they have passed on their learning to others and today 54 tasting panels apply to participate in the proficiency check tests run every year by the IOC as part of its scheme to grant recognition to panels that score well in the tests. These participants are from member countries as well as from non-Members such as the United States, Australia, New Zealand or Switzerland which are keen to discover about sensory analysis applied to virgin olive oil.

But, despite all the IOC's hard work, there are still producing countries where there are no recognised taste panels. The objective of the Organisation is to increase the number of tasting panels that earn recognition, above all with an eye to exports to consumer markets. It is therefore continuing with its drive to set up, train and issue recognition to panels in all its Members, despite the major effort entailed in supplying samples and reference standards.

As a token of its appreciation of the long years of work which have made it possible to recognise and measure the sensory sensations that form an integral part of the hallmark identity of olive oils, the IOC means to commemorate the 25th anniversary of the method in 2012, coinciding with the 100th session of the Council. The commemorative ceremony will pay a special tribute to all those who have collaborated with the IOC since its beginnings and whose professionalism and dedication have made olive oil equate with quality nowadays. ■

The gift of tongues goes digital

There's a recent new addition to the IOC website. Visitors can now browse a technical glossary of terms in Arabic, English, French, Italian and Spanish, the five official languages of the Organisation. The glossary spans four basic subject areas: olive growing, chemistry, olive oil technology and table olive processing. Most of the terms come with a detailed description, and in some cases with self-explanatory images. The plan is gradually to incorporate more photographic material to make the glossary more attractive and easier to understand.

The pace of change in the olive industry in recent years prompted the IOC to bring out this glossary to clarify the proliferation of ambivalent, ambiguous terms and definitions in the olive world. A source of uniform multilingual terminology was needed to make it easier for people inside and outside the industry to communicate with each other.

The great advantage of an online glossary is that it can be added to whenever necessary. In this way users have access to a reference source of helpful, up-to-the-minute information.

Feedback from users is important. It will help the IOC to hone this tool on a continuing basis to make it easier and more worthwhile to use.

To compile the glossary, the IOC Executive Secretariat was assisted by a team of internationally renowned experts whose help was decisive in successfully bringing out this online information source. ■

International Olive Council Shows How to 'Add Some Life' to Everyday Culinary Wardrobe with Olives and Olive Oil during North American Launch Event at Mercedes-Benz Fashion Week in New York

Food and fashion media attending Mercedes-Benz Fashion Week in New York, NY, were treated to a tasting event on 12 September to preview the International Olive Council's new 'Add Some Life' North American campaign and sweepstakes to promote and celebrate the many facets of olives and olive oil, including the flavour, health benefits and sense of delight they add to everyday eating.

Like fashion's "little black dress," olive oil and olives provide versatility, flavour and on-trend health benefits to our everyday culinary wardrobe. As one of North America's most well-known cultural events, Mercedes-Benz Fashion Week provided the ultimate cultural backdrop from which to kick off the IOC's new campaign to promote olive oil and olives.

"Olives and olive oil are attainable indulgences with numerous flavour and health benefits," Jean-Louis Barjol Executive Director of the IOC, said. "As today's consumers have developed a taste for the latest culinary trends, we see an opportunity for growth within the North American market, as well as an opportunity to educate consumers about the health benefits of olives and olive oil."

Chef Michael Schwartz, a restaurateur and 2010 James Beard Award recipient—the United States' most coveted culinary honour—was introduced as the campaign's spokesperson. His cooking and entertaining philosophy exemplifies "adding life" with quality ingredients and great flavours.

'Add Some Life' display.

"I think the more people start to explore the flavours and uses of olives and olive oil, the more they'll understand how they can add flavour and life to almost any meal," Chef Schwartz said.

He and his resident mixologist, Ryan Goodspeed, served newly created olive and olive oil-infused recipes at the event. Throughout the 'Add Some Life' campaign, Chef Michael Schwartz will offer tips for incorporating the ingredients into everyday meals and entertaining.

During the event, Mr. Barjol also unveiled key elements of the North American campaign, including a newly launched consumer web site, www.addsomelife.org, which features on-trend recipes, health and nutrition news and background on the products. He also shared news of a Facebook page and Twitter feed for fans of olives and olive oil to follow for ongoing news and updates. They can be found at www.facebook.com/addsomelife and http://twitter.com/#!/addsomelife.

The North American campaign features a sweepstakes that consumers can enter through the Facebook page. One grand-prize winner will receive a trip to New York and invites to Mercedes-Benz Fashion Week in February 2012.

The 'Add Some Life' campaign will be driven through olive and olive oil recipes, tasting events, and new health and nutrition research and communication. ■

More IOC promotional campaigns in the offing

As promotion gathers momentum, the International Olive Council lines up potential new target markets and weighs up the possibility of extending existing campaigns.

With campaigns underway in China and Russia and the 'Add Some Life' campaign kicking off in the United States and Canada, the IOC is looking in other directions in its drive to showcase olives and olive oil.

The consultancy firm Deloitte recently won the contract to carry out market research on the potential in Brazil for increasing consumption of the two products of the olive tree. When their findings are ready this autumn, they will be posted on the IOC website to invite comments from private industry and institutional stakeholders. The next stop will be the November session of the IOC for a final decision about the campaign, intended for kick-off in early 2012.

Other potential countries under scrutiny are Australia, Japan and South Korea. The first two are not new for the IOC; it ran campaigns there for several years in the 1990s. The main difference now is that Australia is a producer and exporter while Japan is recovering from the devastation caused by the tsunami. On the other hand, South Korea is a whole new ball game.

The Executive Secretariat has commissioned market research in these three countries by the firms Deloitte (for Australia and Japan) and Agerón Internacional (for South Korea). The plan is to present the preliminary findings in November to allow the IOC to narrow down the options to the market that offers the most room for growth.

The China and Russia campaigns will finish at the end of 2011 but the Executive Secretariat intends to submit a detailed proposal in November to extend promotional action in China for a further year.

So, in 2012, IOC promotional campaigns will be up and running in five markets across the globe. ■

The Executive Secretariat turns out in force for EXPOLIVA 2011

The International Olive Oil and Allied Industries Trade Fair has become a permanent, high-profile fixture on the events calendar of the olive oil world. Held every two years in Spain's top olive growing province, it converts the city of Jaén into the bustling hub of the olive world.

When EXPOLIVA 2011 drew to an end on 14 May after a packed four-day programme, the organisers could feel satisfied with the results. Some 48,000 visitors passed through its doors, including over 1,000 trade visitors from 30 countries. Eighty-six media were accredited for the event, which was covered by over 270 journalists from Spain and abroad.

This is just the kind of event where the IOC should be. So, this year a large team set off from the Executive Secretariat to add to IOC visibility at this key gathering, structured around three main events: the international trade fair; a scientific and technical symposium; and an international extra virgin olive oil show where 4,000 tastings were given of 140 brands of extra virgin olive oil.

The Executive Director attended the official opening of the Trade Fair by the President of the Regional Government of Andalusia and had the privilege of welcoming Spanish agriculture minister Rosa Aguilar to the IOC stand.

Later alongside the Secretary of Agriculture of the Andalusian regional government, Clara Aguilera, the Executive Director opened the scientific/technical symposium. In all, 2500 participants attended this large-scale event at which 253 papers were presented in five forums. When taking part in a satellite panel discussion on quality and promotion, Barjol told the audience about what the IOC does, stressing that 'a policy-oriented policy is essential to showcase the extraordinary nutritional assets and organoleptic characteristics of olive oil and should be a key priority for producers and processors alike'. Explaining the IOC's promotional approach, he said that 'the IOC sets outs to create olive oil savvy consumers who are able to make an informed choice about the unique product they buy'.

Over the rest of his stay in Jaén, Barjol spoke to a string of institutional stakeholders and business players from Spain primarily, but also from Argentina, Brazil, Japan, Tunisia and Turkey. He also attended the 90th birthday tribute organised for Don Rafael Gutiérrez, one of the pioneers of the method for the organoleptic assessment of olive oil.

The rest of the IOC team took part in different ways, first of all on the complimentary 96 m^2 stand provided by the *Fundación del Olivar*. The attractively designed stand featured a spacious seating area for visitors to watch DVDs about olives and olive oil and a display of IOC publications. There was also an area set aside for small-scale meetings. Two hostesses were permanently on hand to screen the videos and to give away IOC promotional materials such as flyers, brochures and bags. Through the week the Deputy Director and the Heads of the Technical and Promotion Units and Projects & Environment Department took turns to field queries from visitors. By the end of the Fair, hundreds of trade and non-specialist visitors had stopped by at the IOC stand in search for information or contacts.

Besides taking stints on the IOC stand, Deputy Director Ammar Assabah also

Hostess welcome desk

attended the technical and scientific symposium and took advantage of the opportunity to visit other stands to see the latest on offer in agricultural machinery, mill equipment and olive plants and to chat with exhibitors.

The Head of the Technical Unit, Mercedes Fernández Albaladejo, was invited to sit on the panel of judges for the EXPOLIVA 2011 awards for excellence in extra virgin olive oils while the Head of the Promotion Unit, Ender Gündüz, gave a speech at the presentation of the book *Ad Oleum habendum*. Prefaced by the Spanish and Portuguese agriculture ministries and the IOC Executive Director, this book is a mine of easy-to-read information about olive growing and olive oil production written with the expert help of 23 specialists well known to the olive industry.

The turnout of the team from the Executive Secretariat sent a clear message: it means to intensify its drive to enhance the international exposure of the IOC. ■

The U.S. Import Market: An Inside View

Guest article: Bob Bauer, President, North American Olive Oil Association

While the United States already holds the position of the largest export market for olive oil, it's arguably the biggest land of opportunity for the category as well. Some will point to statistics showing imports of olive oil to the U.S. have risen from 29 metric tons in 1982 to 271,000 metric tons in 2009 and say there's not much room for growth. Those of us in the market know otherwise.

First, let's look at how we got to where we are today, looking first at the 1980s, one of the most important decades in the history of the U.S. olive oil industry. Perhaps it can be called the "Age of Discovery." In the early 1980s olive oil was an unknown to most Americans. Consumption was primarily limited to those of Mediterranean heritage. Outside of that group, those who used it did so sparingly, trying to keep it in their cupboard for use in recipes used only for special occasions. So olive oil, even with its long and rich history, was a relatively unknown commodity in the United States.

Several forces came together in that time to move olive oil from the category of a kitchen novelty to a key component in many households. One was interest by those in the media in healthy food products. Well-established publications and new players on the market, some focused solely on health, began to tout olive oil as a healthy, great-tasting alternative to other fats and oils.

Helping to spread the message was the International Olive Council, which began a public relations campaign in the U.S. in the early 1980s. Using media tours, scientific studies and other means, the IOC provided a host of information and resources for reporters hungry to write articles on this "new" kitchen wonder product.

Marketers in the U.S., some new and some that had been selling olive oil for many years, also began to more aggressively promote olive oil. The industry also looked for ways to work together. By the mid-1980s, members within the Association of Food Industries, an association for the U.S. food import industry, began to talk about forming an olive oil industry group. By the end of the decade, the American Olive Oil Association, which quickly expanded its scope to include Canada and changed its name to the North American Olive Oil Association, began representing the burgeoning industry, focusing on promotion and quality control issues.

If the 1980s was the "Age of Discovery" for olive oil in the U.S., the 1990s through 2005 could be called the "Age of Expansion". Imports of olive oil – imports accounted for more than 99 percent of U.S. consumption in that period – grew from 80,000 metric tons in 1989 to 255,000 metric tons in 2005! The growth of cable television was one factor that helped in that growth. Cooking shows by the dozens began airing and almost all featured chefs using and touting olive oil – for its taste and its health benefits.

Olive oil's health benefits took center stage in 2004 when the U.S. Food and Drug Administration approved the NAOOA's petition to allow marketers of olive oil and products containing olive oil to tout olive oil's health benefits right on the product label. Media outlets across the country ran reports about the health

U.S. IMPORTS OF OLIVE OIL 1982 – PRESENT

Imports of edible olive oils have increased from a level of 64 million pounds in 1982 to 597 million pounds in 2009, showing a significant growth in the consumption of olive oil.

Year	Pounds	Kilograms	Metric Tons	Gallons†
1982	64,364,528	29,194,234	29,194	8,469,017
1983	72,911,102	33,070,759	33,071	9,593,566
1984	91,746,633	41,614,112	41,614	12,071,925
1985	96,777,530	43,896,009	43,896	12,733,886
1986	114,974,299	52,149,634	52,150	15,128,197
1987	139,557,639	63,300,059	63,300	18,362,847
1988	178,696,057	81,052,323	81,052	23,512,639
1989	177,902,401	80,692,340	80,692	23,408,211
1990	214,518,603	97,300,586	97,301	28,226,132
1991	208,070,280	94,375,779	94,376	27,377,668
1992	230,857,604	104,711,573	104,712	30,376,001
1993	267,319,779	121,249,956	121,250	35,173,655
1994	277,883,149	126,041,252	126,041	36,563,572
1995	269,560,101	122,266,114	122,266	35,468,434
1996	248,675,514	112,793,357	112,793	32,720,462
1997	360,433,595	163,484,191	163,484	47,425,473
1998	363,762,321	164,994,022	164,994	47,863,463
1999	358,579,109	162,643,039	162,643	47,181,462
2000	449,452,160	203,860,915	203,861	59,138,442
2001	467,009,821	211,824,657	211,825	61,448,661
2002	488,575,086	221,606,153	221,606	64,286,195
2003	472,847,951	214,472,695	214,473	62,216,836
2004	542,063,544	245,867,258	245,867	71,324,150
2005	563,480,233	255,581,364	255,581	74,142,136
2006	534,267,780	242,331,283	242,331	70,298,392
2007	575,426,700	261,000,000	261,000	75,714,039
2008	599,678,400	272,000,000	272,000	78,905,053
2009	597,473,700	271,000,000	271,000	78,614,961

† Approximate volume calculated from weight.
Sources: U.S. Department of Commerce, the Journal of Commerce, and the International Olive Council

claim. The NAOOA was certain to provide information stressing olive oil's taste and versatility as well. Promotion of the health claim was a major part of the NAOOA's public relations program for several years and continues to be an important message in today's promotion efforts.

QUALITY CONTROL

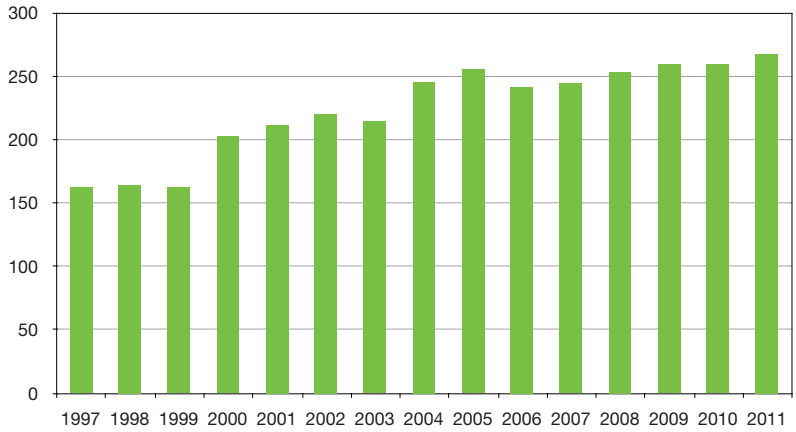
As an emerging market, the U.S. was filled with consumers, retailers and even marketers who needed to be educated about olive oil, so much so that early public relations efforts were directed at retailers; it was imperative they were armed with the information needed to stock quality product. Once that was achieved, the public relations efforts could focus clearly on consumers.

From the start, the industry realized it needed to protect the integrity of the product sold throughout the country. The NAOOA im-

mediately became a signatory to the IOC's quality control monitoring agreement. Members wholeheartedly embraced the requirement for ongoing testing to meet the IOC standard. For more than two decades, the NAOOA has randomly collected retail, foodservice and bulk samples – from members and non-members - from around the U.S. (and Canada) as part of the IOC's quality control program. Nearly 300 samples are being collected in 2011.

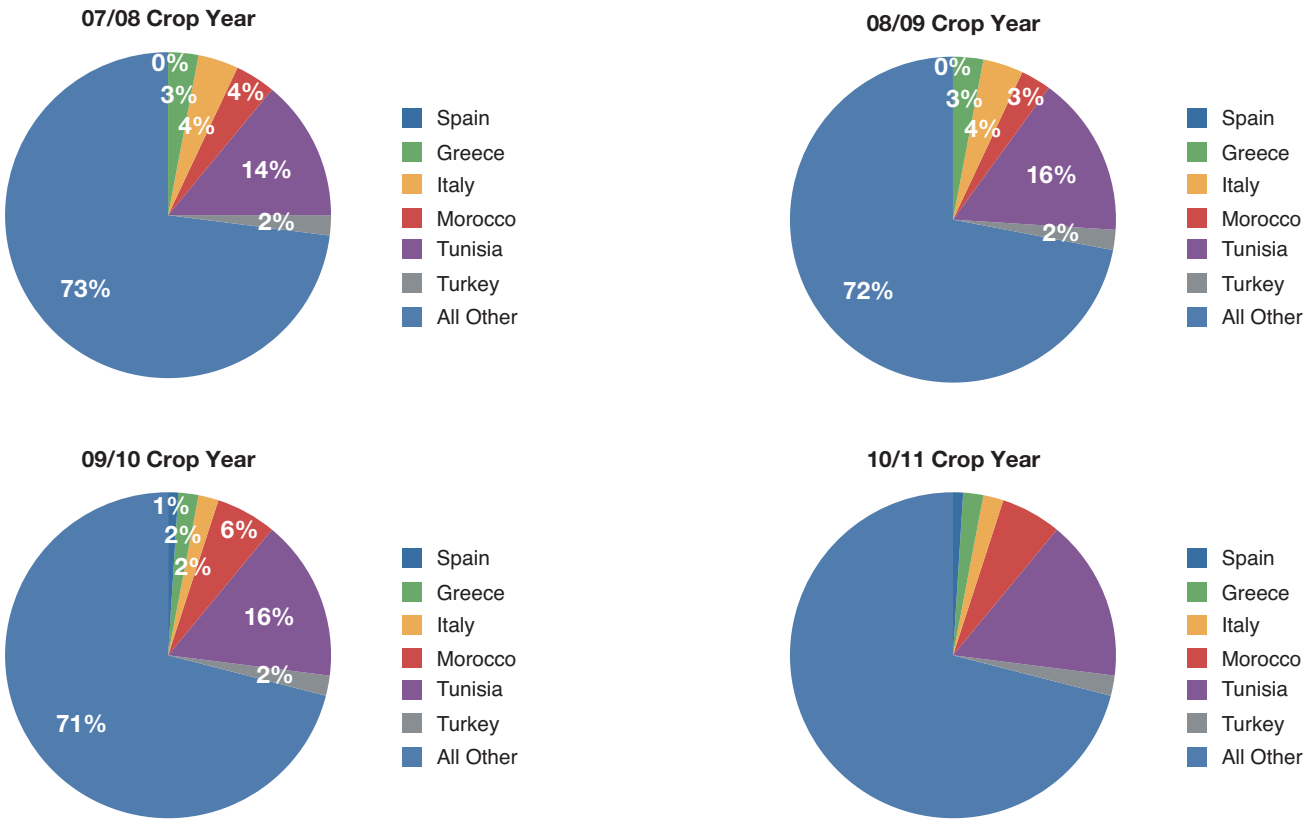
In 2006 NAOOA members, seeking to be able to monitor the market in as timely a manner as possible, voted to budget $10,000 per year to conduct additional testing using IOC-accredited labs and parameters. These

U.S. Imports of Olive Oil
Volume Trend in Metric Tons (000)



* 2011 Estimate based on first 5 months 2011.
Source: USDA.

U.S. Imports of Olive Oil
(% by Country of Origin)



Source: US Department of Commerce

Highlighting Olive Oil's Health Benefits

Since November 2004, the Food and Drug Administration has allowed the following health claim to be made on olive oil labels.

"Limited and not conclusive scientific evidence suggests that eating about 2 tablespoons (23 grams) of olive oil daily may reduce the risk of coronary heart disease due to the monounsaturated fat in olive oil. To achieve this possible benefit, olive oil is to replace a similar amount of saturated fat and not increase the total number of calories you eat in a day."

results are sent directly to the NAOOA, which allows for a faster turn-around time, which is helpful in informing authorities about any problem oils.

Shortly thereafter, the organization implemented the NAOOA Seal Program, a program which allows NAOOA member firms to put the organization's seal on their products. This applies only when the company's product undergoes additional random sampling and testing. Consumers are beginning to look for the NAOOA when they shop for olive oil. The NAOOA Seal is also being requested by retailers for their private label brands. All of the NAOOA testing programs follow IOC protocol and use only IOC-accredited labs and panels.

Domestically produced product has a similar seal program, through the California Olive Oil Council. California accounts for nearly all the olive oil production in the U.S. This year's production has been estimated at more than 1 million gallons, up from 650,000 gallons in 2008 and 870,000 gallons in 2009. Some of this growth is due to super-high-density plantings that started in 1999 and grown in use since. Some within the California industry expect California to be among the leading volume producers of olive oil within the next 10 to 20 years. The growing olive oil industry in California is helping to create even more buzz about olive oil.

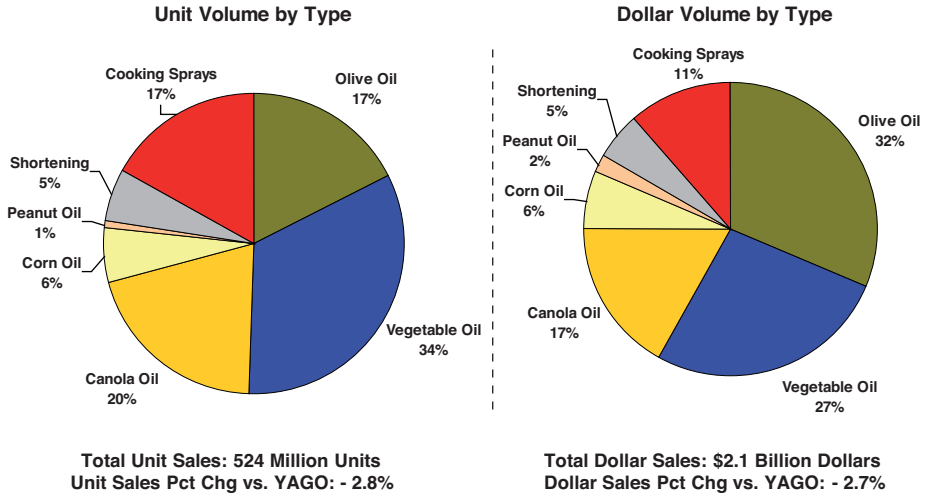
A PRIME TARGET

No matter what level of growth California achieves, the growth in worldwide production of olive oil means efforts must be made to increase consumption. Here are some factors that make the U.S. ripe for such growth:

- Household penetration for olive oil in the U.S. is slightly below 40 percent.
- Nearly three-quarters of the olive oil sold in U.S. supermarkets is sold in east coast states that border the Atlantic Ocean and west coast states that border the Pacific Ocean.
- Olive oil is – rightfully so – continually touted as a premium product – for its taste and its health benefits. Consumers are not tired of hearing this message. In fact, they're looking for continuous reinforcement of that message.

Looking at these three points more closely sheds more light on their importance. Given the size of the U.S. market a gain of even 1 percent in household penetration will have a dramatic impact on consumption. Given that many millions of additional households in the U.S. have the economic means to include olive oil in their diets, a significant increase in household penetration is not only possible but should be expected. That's why efforts such as the new IOC promotion program in the U.S. should prove quite fruitful.

Total U.S. Shortening & Oil:
Shares by Type



Total Unit Sales: 524 Million Units
Unit Sales Pct Chg vs. YAGO: - 2.8%

Total Dollar Sales: $2.1 Billion Dollars
Dollar Sales Pct Chg vs. YAGO: - 2.7%

Nielsen 52 Weeks ending May 14, 2011

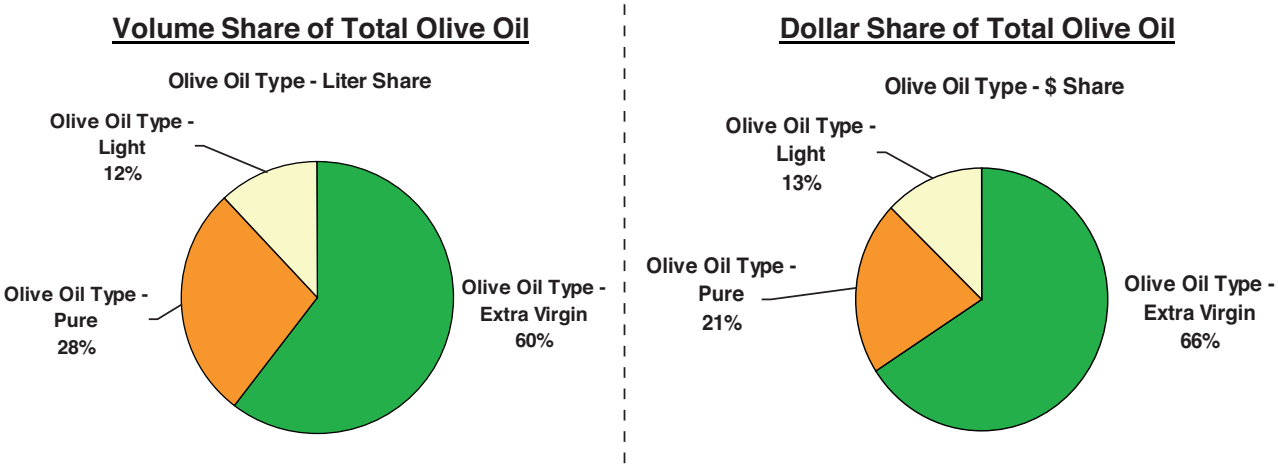
With so much of today's consumption taking place along the east and west coasts, there's a huge market for growth in the center of the country. The NAOOA has been targeting that region, trying to educate those used to using corn oil about the beneficial qualities of olive oil.

Even as consumers are being informed about olive oil's versatility and being encouraged to use it regularly, olive oil has maintained its status as a premium product. Celebrity chefs, for example, often finish off elegant-looking creations by drizzling olive oil on top. In many other instances, they excitedly talk about olive oil as they add it to their dish. The chefs are huge influencers and are the industry's greatest ambassadors.

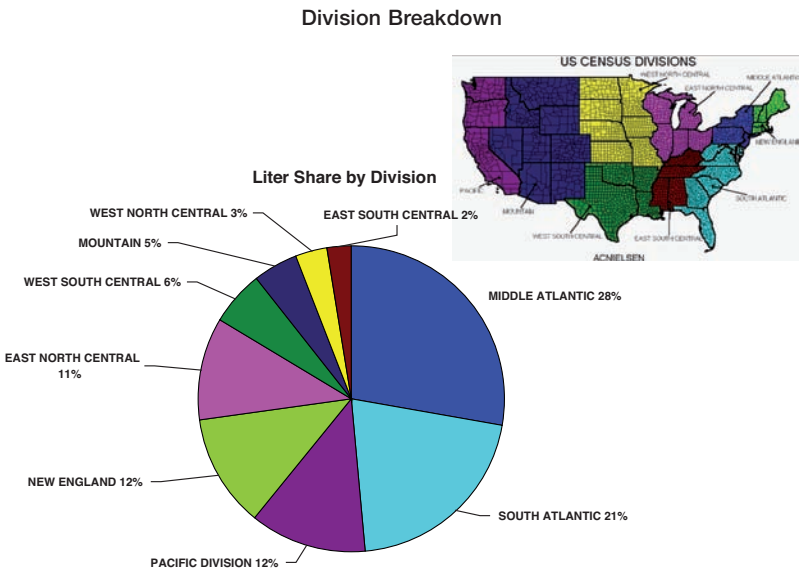
REGULATORY CHANGES

No report on the U.S. market would be complete

Total U.S. Olive Oil:
Type Volume and Dollar Shares



Nielsen 52 Weeks ending May 14, 2011



Nielsen 52 Weeks ending May 14, 2011

without mentioning the Food Safety Modernization Act, the biggest change to U.S. food safety law in more than 70 years. The law applies to all foods but with imports still comprising nearly 99 percent of U.S. consumption of olive oil, it's important to note that relative to import food safety, the legislation:

- requires importers to perform supplier verification activities to ensure imported food is safe;
- authorizes FDA to refuse admission to imported food if the foreign facility or country refuses to allow an FDA inspection;
- authorizes FDA to require certification, based on risk criteria, that the imported food is in compliance with food safety requirements; and
- requires FDA to establish a voluntary program through which imports may receive expedited review of their shipments if the importer has taken certain measures to assure the safety of the food.

In short, companies exporting to the U.S. must be able to demonstrate their product is safe and meets all U.S. requirements. They should expect requests from their U.S. customers for information to provide this proof. They should also be aware FDA will be conducting many more inspections of foreign facilities and that opting out of the inspection is not permissible.

The U.S. is an enticing market. It's a must-have market for the industry. If a company wants to be a part of the market, it must not only agree to ensure its product is safe, it has to be ready, willing and able to prove it. ■

Bob Bauer

About Bob Bauer. Bob Bauer is the president of the North American Olive Oil Association since January 2002, prior to which he served as vice president of the organization for nearly six years. The NAOOA's membership is comprised of U.S. and Canadian companies marketing olive oil in North America and foreign companies supplying olive oil to the North American market. It is part of the Association of Food Industries, an association of nearly 1,000 companies worldwide that fosters international trade of food products. Mr Bauer also serves as president of AFI.

The local olive growing industry in Argentina: development, prospects and potential

Guest article: *Federación Olivícola Argentina* (Argentine Olive Growing Federation)

1. INTRODUCTION

When the Spanish first started to settle in South America in the sixteenth century they would never have dreamt that the first olive orchards they planted for their own consumption would form the foundation stone, centuries later, for the emergence of a constantly growing industry and would turn Argentina into a prominent producer on the world stage.

The olive growing industry is undergoing marked expansion in Argentina. Nowadays, it is faced with a unique golden opportunity given that it has the right natural conditions for production and development, with great added and differential value. This will be the subject addressed in this article.

In recent years, Argentina has climbed to join the ranks of the leading producers of olive oil and table olives, becoming America's top producer and exporter. Translated into figures, it supplies 1% of the olive oil consumed in the world and 5% of the table olives according to data for the 2008/09 season released by the International Olive Council (IOC). In the world ranking, it lies 8th in table olive production, 10th in olive oil production and 6th in terms of its olive oil exports.

Several yardsticks can be applied to measure Argentina's potential in the world olive sector. One of the most prominent gauges is the exponential growth in the number of advanced genetics trees, which are not more than 10 years old on average. As a result, crop production is leading to export growth, particularly to two key countries: the United States and Brazil.

Some of the causes of this expansion can be traced to several factors:

- The varieties planted in the differing local types of soil and climate give products with distinctive and differentiated organoleptic attributes.

- Argentina has one of the widest ranges of varietals in the world, allowing it to create excellent blends or coupages to suit the new profile of the world consumer.

- The bulk of the oils produced in Argentina belong to the top extra virgin grade.

- Argentina has great capabilities for the production of organic olive oil, a segment that is clearly expanding among today's consumers.

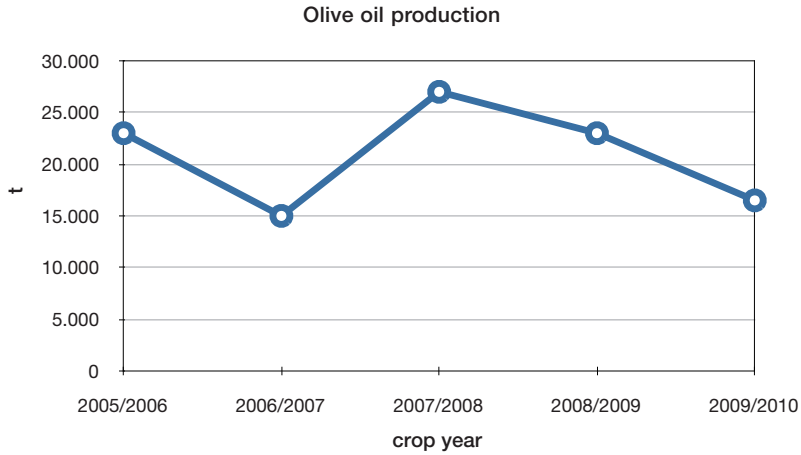
- The olive harvest season in Argentina is in the spring whereas it is in the autumn in the Mediterranean region, which means that the world has access to fresh, newly made olive oils all year round.

- There is plenty of land in Argentina which is rich in natural resources (water, sun, climate) and very affordable compared with world land prices.

For all these reasons, Argentine oils have much to offer the world's ever more demanding consumers.

2. WORLD AND LOCAL PRODUCTION

Olive oil production has experienced constant growth since the late 1990s. In the 1999/00 season Argentina produced 11,000 tonnes, ranking it as the world's tenth biggest producer. Since then, its production has climbed, reaching 18,000 t in 2004/05 and 27,000 t in 2007/08.



Source: Data from the Argentine Ministry of Agriculture, Fisheries and Food

World production of table olives has also been increasing without interruption since the end of the 1990s when it topped 1,343,000 t.

In the 1999/00 season, Argentina was positioned ninth in the world league, with a table olive output of 58,000 t. Ten years later it was producing 220,000 t, keeping in step with world expansion.

This 380% rate of growth is partly explained by the fact that the new olive orchards planted in the 1990s have started bearing crops.

3. PRODUCTION

The industry in Argentina uses more than 105,000 hectares of land to grow olives, concentrated in the key producing provinces (Mendoza, San Juan, Catamarca, La Rioja, Córdoba and Buenos Aires), which have been joined recently by Neuquén.

With over 10,000 hectares of olive orchards yet to start bearing crops, the outlook for production growth is noteworthy. When this area starts to produce, the tonnage available for export is expected to rise considerably.

To give an idea of the extent to which the sector has expanded, at the beginning of the 1990s olive orchards were cultivated on no more than 29,600 ha. There were an estimated 3,000,000 olive trees in the country, which yielded an average 140,000 t nationwide, split evenly between olives for oil and for table olive production.

The Tax Deferral Act (National Act 22.021) passed in 1979 was one of the main State-driven initiatives to inject fresh life into the industry and allowed olive orchards to spread outside their traditional growing regions. By the end of the 1990s over 70,000 ha were under olives, 70% of which was for oil and 30% for canning olives.

In terms of job creation, the olive industry has stepped up its demand for labour. It is one of the driving forces behind the regional economies of Argentina and has a significant impact on the provinces of Catamarca, La Rioja and Mendoza. At present, the industry directly provides employment for over 15,000 people. At harvest time, this number is swelled by 10,000 seasonal workers. In addition, it is estimated to generate 45,000 indirect jobs.

4. ARGENTINE EXPORTS OF OLIVE OIL AND TABLE OLIVES

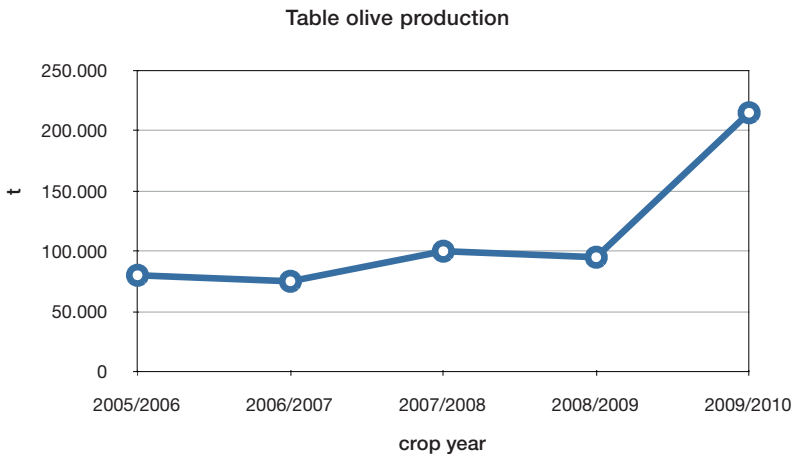
Within a question of 10 years Argentina has trebled its exports in volume terms. In fact, between 2000 and 2010 exports of table olives and olive oil recorded aggregate volume growth of 163%.

When exports are broken down by province, Catamarca emerges in top position for both olive oil and olives. It was also the province whose foreign trade earnings increased the most during this period.

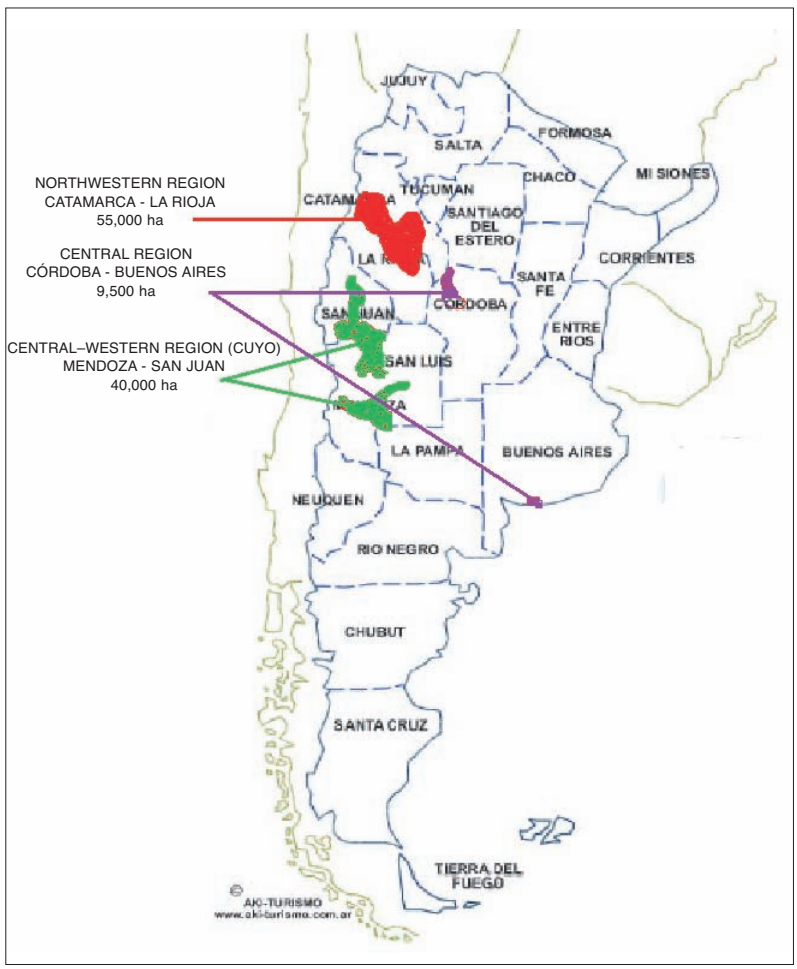
The province of Mendoza has followed in the same direction, recording significant hikes in the levels of its exports of both olive oil and table olives.

The export performance of the rest of Argentina's provinces has varied. Export earnings from oil and olives doubled in the province of Buenos Aires, but it has to be remembered that it only accounts for 5% of the total export earnings. La Rioja, the second province in terms of export earnings, also saw its earnings increase to 50 million dollars in 2010, compared with just over 47 million dollars 10 years earlier.

The United States is currently the main destination for Argentine exports, taking more than 10,000 t of extra virgin olive oil, followed by Brazil with 8,000 t. The third export destination is Uruguay, which imports 460 t, with Chile following behind with 380 t. Expressed in percentage terms, the United States takes 50% of the oil pro-



Source: Data from the Argentine Ministry of Agriculture, Fisheries and Food



Source : *Federación Olivícola Argentina.*

Table 1. Expected olive growing area (ha) in Argentina after the application of the Tax Deferral Acts

Province	Prior area	Tax deferral area	Total area
Mendoza	13700	300	14000
Córdoba	5000	470	5470
San Juan	4800	13800	18600
La Rioja	2900	27000	29900
Buenos Aires	1800	0	1800
Catamarca	1400	30000	31400
Total	29600	71570	101170

Source : Olive growing in the arid valleys of Northwest Argentina (provinces of Catamarca, La Rioja and San Juan), M. Gómez del Campo, A. Morales-Sillero, F. Vita Serman, M. C. Rousseaux & P. S. Searles, published in Olivae 114.

duced in Argentina while Brazil takes 40 per cent. The remaining 10% is exported to more than 35 countries.

In value terms, Argentine exports in the year 2000 were worth a total of 4 million dollars. By 2009, they were worth 62 million dollars.

Bulk and packed exports of olive oil

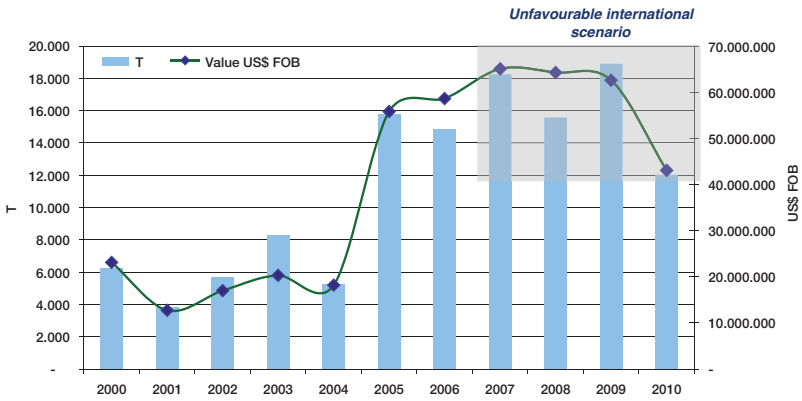
A review of exports by format type shows very strong growth of bulk exports of olive oil, with a volume share of close to 20,000 t compared with almost 5,000 t of packed exports.

In volume terms, exports of packed oil have seen steady growth since 2004/05, with a peak in the 2007/08 season.

Argentina: an exporter of extra virgin olive oil

Importantly, 96% of the olive oils exported by Argentina are virgin oils, mostly belonging to the extra virgin grade; 3% are blended and 1% is refined. This gives Argentina a differential advantage when positioning itself as a world-standard supplier, given the extremely high quality of the oil it has available for export.

Movements in total olive oil exports



Source: INDEC.

Table olive exports

In 2007/08, Argentine table olive exports amounted to more than 90,000 t, showing a 29% increase from the year-ago level of 70,000 t. It is interesting to note that these exports only amounted to 36,000 t at the end of the year 2000. This gives a clear indication of the marked growth in this segment.

Brazil was the chief destination for Argentina's table olives (2007/08 crop year), importing over 53,000 t worth more than 63 million dollars FOB. The United States was next, taking more than 22,000 t generating 35 million dollars in earnings. It is noteworthy that between the two of them, these countries took 83% of Argentina's exports. The remaining 17% went to several countries, notably Venezuela, Canada, Uruguay and Chile.

5. MOUNTING WORLD OLIVE OIL CONSUMPTION: AN OPPORTUNITY FOR ARGENTINA

Like production, world consumption of olive oil is going up by the year. There is every indication that this upward trend will not stop. In fact, the global market is expected to continue to expand in the current decade, bolstered by the proven benefits of olive oil in a healthy diet.

Although the European countries are the world's top consumers of olive oil, consumption growth is being led by the United States where consumption has gone up from 169,000 t in 2000 to 260,000 t ten years later.

The picture is somewhat similar for Brazil whose consumption has doubled in the last ten years.

Consumption growth in these two countries is an excellent opportunity for Argentine exports, particularly bearing in mind the country's close ties with both markets.

Consumption in Argentina

Although local consumption of olive oil is experiencing year-on-year growth it is still very much below the average of the main producing and consuming countries. Argentina consumes less than a quarter of a litre of olive oil per person and year, compared with 12 litres in Spain. The reason is that Argentineans still have a strong taste for seed oils, particularly sunflower oil, of which they consume some 16 kg per inhabitant and year.

But Argentina is a country where the population is primarily descended from European immigrants – preponderantly of Spanish and Italian extraction – with eating habits deeply rooted in the Mediterranean. Hence, the scope for developing the local market looks more than promising. To achieve this objective, campaigns are needed to educate consumers about the benefits, advantages and unique flavour of olive

Olive oil: export volume by province

	Volume (t)		
	2000	2005	2009
Buenos Aires	410.42	1,279.49	687.96
Catamarca	0.00	1,141.41	4,113.43
Córdoba	140.31	211.65	171.37
La Rioja	4,376.83	6,867.70	4,899.78
Mendoza	583.56	5,105.60	5,310.68
San Juan	921.07	2,646.14	3,014.03
Santa Fe	2.25	79.15	1,683.88
Others	7.27	56.21	56.10
WHOLE COUNTRY	**6,441.71**	**17,387.33**	**19,937.23**

Source: Análisis de la situación internacional y exportaciones. Años 2000 a 2009. Juan Carlos Antuña.

Olive oil: export volume by country of destination

	Volume (t)		
	2000	2005	2009
Brazil	5,600.11	4,500.37	7,862.30
Canada	0.82	102.99	87.33
Chile	223.78	574.07	386.48
United States	460.06	7,536.05	10,097.79
Uruguay	104.29	369.56	467.58
Spain	0.00	2,510.10	267.20
Italy	0.00	1,518.49	160.54
Rest	52.64	275.70	608.02
TOTAL	**6,441.71**	**17,387.33**	**19,937.23**

Source: Análisis de la situación internacional y exportaciones. Años 2000 a 2009. Juan Carlos Antuña.

Olive oil exports, 2000-2010

	US$		t		US$/t	
	Packed	Bulk	Packed	Bulk	Packed	Bulk
2000	19,120,662	3,996,670	5,005	1,207	3,821	3,312
2001	9,368,189	3,350,085	2,607	1,194	3,594	2,805
2002	12,427,538	4,571,267	3,450	2,197	3,602	2,080
2003	9,612,194	10,704,933	3,212	5,051	2,992	2,119
2004	12,437,170	5,757,430	3,012	2,249	4,130	2,561
2005	13,117,358	42,699,785	3,158	12,603	4,154	3,388
2006	20,886,031	37,739,789	4,594	10,250	4,547	3,682
2007	24,771,711	40,310,591	5,280	12,960	4,692	3,110
2008	30,653,539	33,635,407	5,723	9,848	5,356	3,416
2009	23,386,842	39,233,399	4,847	14,056	4,825	2,791
2010	22,474,771	20,603,765	4,876	7,152	4,609	2,881

Source : INDEC.

oil and to make them more sophisticated.

6. THE VARIETIES OF THE NEW WORLD: THE CHALLENGE OF OFFERING VARIETAL QUALITY AND ORIGINALITY

As explained earlier on in this article, the olive industry in Argentina saw a revival in the 1990s. New orchards were planted with a range of varieties owing to the emergence of new producing areas generating high levels of investment. These new undertakings placed particular importance on agronomic and genetic questions, oil production technology and sophisticated production processes, all of which helped to raise yields and quality.

One of Argentina's strategic advantages is its monovarietal orchards, which produce large volumes of monovarietal olive oils, most notably Manzanilla aceitera, Arbequina, Barnea, Picual, Coratina and Frantoio. The first two – Manzanilla and Arbequina – are grown on the biggest acreage.

According to the latest surveys, the varieties can be identified by the source area of the orchard:

- Valle Central de Catamarca (province of Catamarca): Arbequina, Manzanilla and Coratina
- Bolsón de Pipanaco (province of Catamarca): Arbequina, Manzanilla and Picual
- Tinogasta and Fiambalá (province of Catamarca): Arbequina and Coratina
- Chilecito (province of La Rioja): Arbequina, Barnea, Picual and Coratina
- La Rioja Capital (province of La Rioja): Arbequina, Manzanilla and Picual
- Poman (province of Catamarca): Arbequina, Barnea, Coratina and Frantoio
- San Juan (province of San Juan): Arbequina, Frantoio, Picual, Coratina and Changlot Real
- Jachal and Rodeo (province of San Juan): Arbequina and Changlot Real
- Oasis Norte and Centro (province of Mendoza): from 2005, over 2000 ha of monovarietal orchards were planted

with Arbequina, Picual, Coratina and Farga
- Oasis Sur - San Rafael (province of Mendoza): Arbequina and Arauco
- Coronel Dorrego (province of Buenos Aires): Arbequina, Farga, Nevadillo and Frantoio.

The Arauco variety

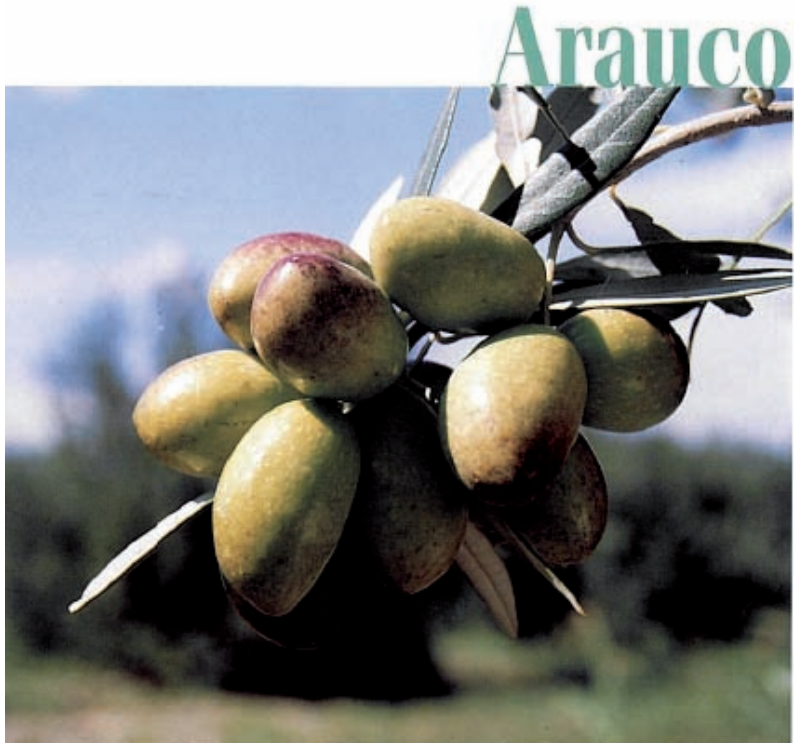
Argentina has another asset: the native Arauco variety, which has very distinctive, clearly defined characteristics.

Its history goes back to the late 17th century when it is said that King Carlos III of Spain ordered the felling of all the olive orchards in the Viceroyalty because they competed with Seville's olive groves.

However in Arauco in what is the modern-day province of La Rioja, Doña Expectación Fuente de Ávila managed to save one plant.

Over the years, that little plant was used to propagate countless others across the Arauco valley and in the process became the "father" of olive growing.

True story or not, the Arauco is the only local variety and the end result of numerous selections and crosses.



The fruit of the Arauco is generally large, elongated and asymmetric. It has an excellent flesh-to-stone ratio, which is why it mostly goes for canning.

Arauco olives give very characteristic oils rated highly for their organoleptic properties. Experts consider it to be the 'Malbec' of the country's olive oils, drawing a parallel with the wine industry and with the way in which this variety of grape is identified with Argentina as its home.

7. ORGANIC OLIVE OIL: A PREMIUM PRODUCT IN STEP WITH CURRENT CONSUMER TRENDS

This type of oil matches the top ranking virgin olive oil commonly known as extra virgin. Argentine organic olive oil is certified – a certification recognised by the European Union – which generates above-average earnings because of its added value. Despite the advantages open to Argentina for selling to Europe, 95% of its exports go to the United States. The second next destination is Japan for packed product, but it accounts for less than 1% of total exports.

Just over 4,000 ha are currently dedicated to organic olive production. These are located principally in the provinces of Córdoba and Buenos Aires, which have recently been joined by the mountain areas of the provinces of Catamarca and La Rioja. Sixty percent of

aggregate production is channelled into olive oil production and the rest goes for table olives.

The varieties used for organic growing are Arbequina, Farga, Nevadillo, Frantoio and Picudilla.

Concluding remarks

Olive growing is one of Spain's major legacies in Argentina. After gradually developing, this crop has seen heavy expansion in recent years. The outlook for local production and the local industry is very bright, based on a production sector in expansion and a commitment to the distinctive premium products that Argentina's olive growing has to offer the world. In this article we have looked to give a clear overview of the status and distinguishing features of olive growing in Argentina that will allow us to continue positioning our olive oils and table olives as products of international calibre. ■

Federación Olivícola Argentina

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Crop production performance and quality of three varieties of olive grown under irrigation in the Settat region of Morocco: Arbequina, Koroneiki and Picholine marocaine

A. Mahhou, Z. Taiebi, A. Hadiddou, A. Oukabli & A. Mamouni

ABSTRACT

The purpose of this study was to determine the optimal harvest date, yields, oil polyphenol content, oil content and oil stability of three varieties of olive – Arbequina, Koroneiki and Picholine marocaine – cultivated in irrigated conditions. The optimal harvest period was identified between 26 November and 16 December when the maturity index of the olives was 2.89, 2.7 and 2.6 for Arbequina, Koroneiki and Picholine marocaine, respectively. Oil content was 25, 24 and 21% in the same order of varieties. The maximum polyphenol levels recorded for the three varieties during the period from 26 November to 16 December were 1 823, 2 191 and 2 113 ppm. A very strong correlation was noted between (i) oil content and maturity index (logarithmic correlation) and (ii) polyphenol content and maturity index (polynomial correlation). Variety was observed to have a significant effect on the physico–chemical characteristics of the oils, namely peroxide value, acidity, total polyphenols and UV absorbance at 232 and 270 nm. Based on the changes in physico–chemical characteristics, the Arbequina oil was ranked as the least stable, followed in ascending order of stability by Picholine marocaine and Koroneiki (113, 143 and 155 days, respectively).

Key words: olive tree, Picholine, Morocco, Koroneiki, Arbequina, oil, harvest, polyphenols

1. INTRODUCTION

Olive growing has expanded significantly in Morocco where olive trees are cultivated on 740 000 ha (MAPM, 2009). Approximately 1.5 million tonnes (t) of olives are produced. This represents an increase of 76% from the level of the season before and of 102% versus the average for the last five years. This crop gives some 160 000 t of olive oil, i.e. almost double the tonnage produced the season before, and 90 000 t of table olives. Domestic output generally records large year-to-year fluctuations due to the on/off year pattern of crop production as well as to the combined effect of lack of orchard care and drought, particularly in the case of rainfed orchards. High productivity is achieved under irrigation, with average yields ranging between 1.6 and 3 t/ha although they may reach 4 t/ha, and even 6 t/ha (MADRPM, 2004).

The distinguishing feature of the varietal structure of Morocco's olive orchards is the predominance of the dual-purpose Picholine marocaine, which accounts for more than 96% of the country's olive resources. The rest is made up of several varieties, in particular Picholine du Languedoc, Meslalla, Gordal, Manzanilla and Ascolana Dura, located in irrigated areas (Haouz, Tadla and El Kelaâ) and some Spanish and Italian varieties (Picual, Frantoio, Hojiblanca...) cultivated in the North (Chefchaouen and Tetuan especially). In recent years, growers have planted large areas of the low-vigour Arbequina-i 350 variety at very high densities. The small-sized fruit of this variety goes solely for oil extraction.

The oil and moisture content of olives varies according to cultivar and growing conditions. For instance, in Morocco, oil content expressed as percent of dry weight is 37% for Arbequina and 30% for Picholine marocaine (Boulouha, 2006). Values of 25% and 23% for oil content on a fresh weight basis have been reported for Koroneiki and Arbequina respectively in an orchard planted at a density of 178 trees/ha in the region of Meknès (Ouazzani *et al*., 2002). In Spain (Córdoba), dry-weight oil contents of 55.1%, 55.7% and 53.1% (Ramirez and Rallo, 2005; Caballero *et al*., 2005) are reported respectively for Arbequina, Koroneiki and Picholine marocaine. In Catalonia, the dry-weight oil contents for these varieties in the same order are 50.5%, 49.3% and 46.6% (Tous *et al*., 2005). In Australia, the oil content of Arbequina and Koroneiki expressed as a percentage of dry weight is 61.9% and 47.8%, respectively (Sweeney, 2005). When related to fresh weight, values of 22–27% and 24–28% are reported for the oil content of Arbequina and Koroneiki (Vossen, 2005).

Fruit maturity determines approximately 30% of the quality and quantity of olive oil obtained (Montedoro, 1989). The stage of fruit ripeness does in fact have a highly significant impact on oil yield, which increases on average by 7.2% when the olives turn from the green to the semi-black stage, and by 10.1% when they go from semi-black to black. In short, it increases by 17.3% overall. This is believed to coincide with the stage of accelerated biosynthesis during oil formation inside the olives (Chimi and Atouati, 1994). The stage of fruit maturity must be determined on the basis of objective criteria allowing for variety and specific climatic factors.

It is also advisable to track the changes in the phenolic compounds. These substances affect the organoleptic characteristics and oxidative stability of olive oil (Chimi, 1987, Chimi *et al*., 1990). The quantitative composition of the volatile products in the olive fruit changes through maturation. The volatile fraction of the oil is affected by the degree of ripeness of the olives from which it is extracted. Montedoro *et al*. (1978) reported a close correlation between the date of fruit maturity and the total concentration of volatile compounds in the oil. Total volatiles concentration increases as the fruit changes from the green to the semi-black stage, only to move in the opposite direction on changing from semi-black to black. The same tendency was recorded in total phenolic compounds.

Hence, cultivar and growing environment play a crucial part in the volume and quality of oil obtained. It is important to study the kinetics of oil accumulation during fruit ripening. After a specific stage of fruit ripening, oil yield appears to increase; however, the increase is due to moisture loss as opposed to any real gain in glycerides. Full maturity is believed to be reached when there are no green olives on the tree, which coincides with the period when all the skin has darkened (semi-black stage). At this stage, oil content is at its highest and moisture content is at its lowest. Oil quality is better at this stage because it is when the phenolic and volatile compounds peak (Fontanazza, 1988). Olives harvested early give a low yield of very green, fruity oil with a low degree of acidity. At this stage the oil is very prone to oxidation due to its high chlorophyll content, which encourages oxidation in the presence of light (Rahmani and Saad, 1989). Conversely, if harvesting is delayed, the fruit give a higher yield of oil with a slightly higher acidity; it is straw yellow in colour and is generally less fruity. Atouati (1991) reported that total polyphenols content peaks at the semi-black stage. These compounds improve oil stability and have a positive effect on its organoleptic characteristics.

Determining the right time to harvest is of vital importance in producing quality oil. The purpose of this paper was to evaluate and compare the performance of two foreign varieties, Arbequina and Koroneiki, with Picholine marocaine and to determine the optimal time to harvest these varieties in the conditions of Chaouia in the Settat region of Morocco.

2. MATERIALS AND METHODS

2.1 Site characteristics

The varieties surveyed - Arbequina, Koroneiki and Picholine marocaine – were grown on a private property belonging to Mr Benchaib in the region of Settat (Morocco). The trees were planted at a density of 312 trees/ha. The two foreign varieties of tree were nine years old while the Picholine marocaine trees were 11 years old. They were therefore grown in the same soil and climate conditions and received the same cultural care.

2.2 Sampling

Ten uniform trees of each variety were chosen at random and marked with paint. On each sampling date a composite sample (5 kg) was collected at random from each plot at shoulder height from four different shoots (Table 1).

TABLE 1
Fruit sampling dates

Sample number	Sampling date
1	13/11/2007
2	19/11/2007
3	26/11/2007
4 *	16/12/2007
5 *	24/12/2007
6	07/01/2008

* Harvest period in the orchard.

After careful mixing, 1 kg of olives was taken per sample. These were packed in plastic sachets and sent to the laboratory for freezer storage at -20°C until the carpometric and physico–chemical analyses were performed.

2.3 Tests

Olive tests

Olive maturity index (MI)

This index is determined by assessing the colour of 100 olives picked randomly from a 1 kg sample. The olives are ranked in eight colour categories, ranging from fruit with a deep green skin to fruit with a black skin and dark flesh.

The maturity index is calculated as follows:

$$\text{Maturity index} = \frac{[(0\times n_0)+(1\times n_1)+(2\times n_2)+\ldots+(7\times n_7)]}{100}$$

where n_0, n_1, …, n_n is the number of fruits in each of the colour categories now listed:

MATURITY INDEX

0: skin colour deep green
1: skin colour deep yellow–yellowish
2: skin colour yellowish with reddish spots
3: skin colour turning reddish or purple
4: skin colour black with green flesh
5: skin colour black with flesh turning purple halfway through to the stone
6: skin colour black with all the flesh purple through to the stone
7: skin colour black with all the flesh darkly coloured

Carpometric characteristics of the olives

Fruit weight, stone weight and flesh weight were determined in a sample of 100 olives.

Fruit moisture

Determination of whole-olive moisture content

The flesh and stones were separated beforehand and crushed in a large traditional copper mortar. After careful blending, two test samples each weighing 50 g were dried to constant weight in an oven at 103 ± 2 °C. The resultant moisture content was per 100 g of olives.

- **Determination of moisture content of fruit flesh**

Fifty olives were selected at random and their stones were removed. The flesh was crushed in a mortar and two 10-g test samples were dried in the same conditions as above. The resultant moisture content was per 100 g of flesh.

Oil content of the olives

Soxhlet method

Approximately 70 g of olives were crushed in a mortar and dried to constant weight in an oven at 105 °C (≈ 42 h).

The oil recovered was weighed (M) and the oil content (expressed as percent of fresh and dry matter) was calculated according to the following formulas:

$$\text{FMO (\%)} = \frac{M \times 100}{M_0}$$

$$\text{DMO (\%)} = \frac{M \times 100}{M_1}$$

where: - FMO = oil content expressed as percent of fresh weight

- DMO = oil content expressed as percent of dry weight
- M = weight of oil extracted
- M_0 = weight of sample fresh matter
- M_1 = weight of sample dry matter

Nuclear magnetic resonance method (NMR)

Seventy grams of fresh olives were placed on preweighed Petri dishes according to the protocol of Del Río and Caballero (2005). The olives were desiccated in an oven at 105 °C for 42 hours and the dishes were re-weighed to determine the dry weight. Lastly, a test tube was filled with the sample to a depth of 3–4 cm and placed inside the NMR probe.

Phenolic compounds in the olives

The phenolics were extracted from the olive fruits by the modified method of Fantozzi and Montedoro (1978). The total phenols in the water/alcohol extract of the olives were determined according to the method of Vázquez-Roncero (1978). The results for the phenolic fraction were expressed in relation to the fresh flesh:

$$TPC = \frac{8 \times 10^3 \times u}{W}$$

where:

- *TPC* = total phenolics concentration, expressed in mg of phenolic compound per 100 g of fresh flesh
- $u = \mu$g of phenolic compound per ml
- *W* = sample of olive flesh, in grams

Oil tests

Laboratory tests were performed to determine the free acidity, peroxide value and polyphenols in order to assess the changes in the stability of the oil produced from each variety.

Free acidity

This parameter was determined using the Wolff method, which entails measuring the fatty acids released during hydrolysis of the triacylglycerol chains with a titrated solution of KOH according to the following reaction (Wolff, 1968).

The results are expressed as % of oleic acid (m/m) according to the following equation:

$$\text{Acidity (\% oleic acid)} = \frac{282 \times V \times N}{10 \times W}$$

where:

- V = volume of NaOH solution (ml)
- N = titer of NaOH solution
- W = oil sample (g)

Peroxide value

The first stage of oxidation can be monitored by identifying and measuring peroxide formation. In the presence of potassium iodide in an acid medium, peroxides produce iodine which is then measured by a titrated solution of thiosulphate (T). In this determination 1.5 g of olive oil were placed in a 250-ml Erlenmeyer flask to which a mixture of chloroform and acetic acid was added. Next, 1 ml of potassium iodide was added. The flask was quickly sealed and shaken for one minute, and then left for 5 minutes away from light, at ambient temperature. Next, 75 ml of distilled water were added with some drops of starch as indicator. The mixture was shaken vigorously and the released iodine was titrated with a solution of sodium thiosulphate until it turned a dirty white colour.

NB: The blank sample was prepared in the same conditions, but without oil.

$$PV = \frac{(S - B_0) \times N \times 1000}{W}$$

- S = volume of sodium sulphate (ml) for sample
- B = volume of sodium sulphate (ml) for blank
- N = normality of sodium thiosulphate solution
- W = test sample mass (g)

Total polyphenols

The method proposed by Vázquez-Roncero (1978) was used to determine the total polyphenols. The principle entailed is to reduce a mixture of phosphomolybdic acid in an alkaline medium. 10 g of oil were weighed and diluted with 50 ml of hexane and placed in a decanter. The polyphenols were extracted three times with 20 ml of methanol: water (60%: 40%), shaking each time for 2 min 30 s. For each extraction, the lower layers were decanted directly into a 100-ml flask. Distilled water was added to make up the mixture, giving the polyphenols solution. In a graduated flask 35 ml of distilled water were placed with 15 ml of the polyphenols solution and 2.5 ml of Folin-Denis reagent. The mixture was agitated to homogenise and left to rest for 3 min. 5 ml of the NaOH 6% solution were added and made up to the flask line with distilled water. The mixture was blended carefully again.

The blank was prepared in the same conditions as the oil sample. After being left to rest (45 min minimum), the absorbance was recorded at 725 nm using a spectrometer.

Absorbance in ultra violet (K_{232} and K_{270})

The oil is dissolved in the required solvent and the extinction of the solution is determined at the desired wave length with reference to the pure solvent. The specific extinctions are calculated from the spectrophotometric readings. Approximately 0.1 g of the prepared olive oil sample was weighed into a graduated 10-ml flask, made up with cyclohexane and shaken to homogenise. The resultant solution must be perfectly clear. A quartz cuvette, 1 cm thickness, was filled with the solution and the extinctions were measured at the wavelengths of 232, 266, 270 and 274 nm, using cyclohexane as reference. The extinction values must lie within the range 0.1 to 0.8.

$$K_{270} = \frac{E}{c. \times s.}$$

- **E:** extinction measured at 270 nm
- **c:** concentration of the sample
- **s:** thickness of the cuvette, in cm

Number of determinations and statistical analysis

All the laboratory tests were performed in duplicate. The results expressed are the average of two determinations. Minitab was used to analyse the results for analysis of the variance and the descriptive statistical calculations: mean, standard deviation, etc.

Results and discussion

I. Maturity index

The changes in the maturity index of the olives are reported in Table 2 and plotted in Figure 1. This index rose on average from 2.00 to 4.73 between the first and last sampling date.

In the soil and climatic conditions of the orchard and in the crop year concerned, the Arbequina variety ripened earlier than Koroneiki, which in turn matured ahead of Picholine marocaine.

II. Carpometric characteristics of the olives

Fruit weight increased with maturation in the varieties studied until they reached their maximum weight at full maturity (Table 3). This tendency has also been reported by Atouati (1991). The average weight of Picholine marocaine olives at the black stage (= 4.93 g) is much higher than that reported by Atouati (1991) (= 3.03 g) in the Haouz region of Marrakech. The average weight of the Arbequina olives (= 1.75 g) also exceeded the range (0.8 – 1.2 g) reported in the literature (http://www.orodeldesierto.com/francais/variedades-aceite-oliva.html). In Australia, the average weight reported for Arbequina is 1.89 g, with a flesh-to-stone ratio of around 6.07, i.e. 83.52% (Sweeney, 2005). The average weight of 1.3 g reported for Koroneiki olives is greater than the value reported in the literature (0.3 – 1.0 g). Specifically, Sweeney (2005) has reported a fruit weight of 0.96 g for Koroneiki fruit with a flesh-to-stone ratio of around 4.51 or 77.83%.

The average fresh weight of the fruit (fw FR) was determined according to the categories defined by Del Río and Caballero (1994) (1. Very low: < 2; 2. Low: 2-4; 3. Medium: 4-6; 4. High: 6-8; 5. Very high: > 8). Low values were recorded for the Arbequina and Koroneiki olives and medium values for the Picholine fruit. Using the categories established by Del Río and Caballero (1994) for the fresh weight of the stone (Very low: < 0.2; Low: 0.2-0.4; Medium: 0.4-0.6; High: 0.6-0.8; Very high: > 0.8), low values were recorded for the Arbequina and Koroneiki stones and medium-to-high for Picholine marocaine. The flesh-to-stone ratio of the three varieties was between 5.50 and 6.0. On the basis of this criterion, Del Río and Caballero (1994) defined the following categories: (i) Low (< 5.0), (ii) Medium (5.0-7.5), (iii) High (7.5-10.0) and (iv) Very high (> 10.0).

TABLE 2
Changes in the maturity index of three varieties of olive cultivated in the Settat region of Morocco in the 2007/08 crop year

Sampling date	Arbequina	Koroneiki	Picholine marocaine
13/11/2007	2.11	2.03	1.87
19/11/2007	2.49	2.25	2.14
26/11/2007	2.89	2.70	2.59
16/12/2007	3.93	3.61	3.23
24/12/2007	4.75	4.24	3.71
07/01/2008	5.17	4.89	4.14

III. Composition of the olives

1. Moisture content

The moisture content of the three varieties of olive dipped through the sampling period. From highest to lowest, content ranged from 58.73%–54.87% for Picholine marocaine, 55.44% – 51.89% for Arbequina and 49.04%-44.44% for Koroneiki.

According to the classification proposed by Del Río and Caballero (1994) for olive moisture content (Very low: <40; Low: 40–50; Medium: 50–60; High:

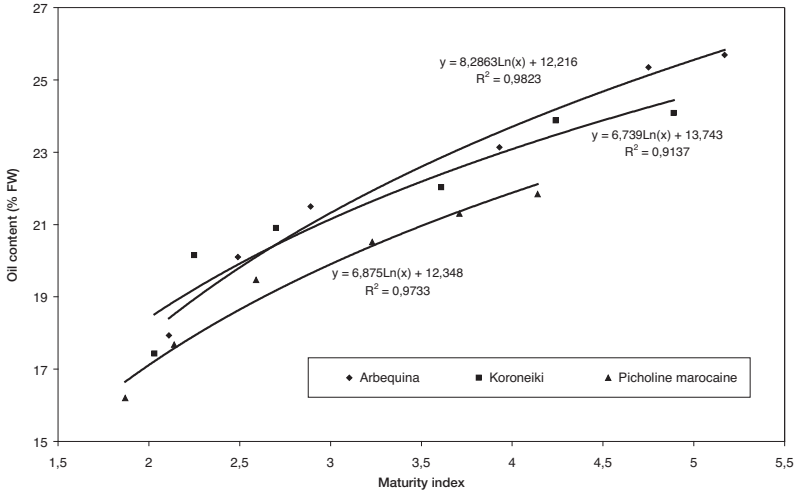
60–70; Very high: >70), Picholine marocaine and Arbequina have a medium moisture content while Koroneiki has a low content.

2. Oil content

2.1. Assessed by nuclear magnetic resonance (NMR)

The oil content of the olives was determined by nuclear magnetic resonance (NMR) of two sub-samples of whole olives, dried but not crushed (Del Río and Romero, 1999). Oil content (% DW) increased in all three varieties, going up from 40 to 52% in Arbequina, from 42 to 50% in Koroneiki and from 38 to 46% in Picholine marocaine (Table 4). Hence, it recorded respective increases of 30, 19 and 21%.

Figure 1. Relationship between maturity index and oil content (%FW) in three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year



The oil content of the olives on a dry weight basis increased with ripening in all three varieties. Del Río and Caballero (1994) defined the following categories for this content: (i) Very low (< 30); (ii) Low (30–40); (iii) Medium (40–50); (iv) High (50–60) and (v) Very high (> 60). On the basis of these categories, at a maturity index of around 4.5, Arbequina olives have a high oil content while Koroneiki and Picholine marocaine have a medium content.

TABLE 3
Changes in the carpometric characteristics of three varieties of olive cultivated in the Settat region of Morocco in the 2007/08 crop year

Variety		Sampling date					
		13/11/07	19/11/07	26/11/07	16/12/07	24/12/07	07/01/08
Arbequina	Weight 100 olives	157.4	168.3	169.2	175.9	174.3	175.0
	Weight flesh 100 olives	132.3	142.4	143.2	150.3	148.6	149.7
	Weight 100 stones	25.1	25.9	26.0	25.6	25.7	25.3
Koroneiki	Weight 100 olives	115.1	118.7	121.1	128.3	130.1	132.9
	Weight flesh 100 olives	96.6	96.8	101.3	107.1	111.2	112.8
	Weight 100 stones	18.4	21.9	19.8	21.2	18.9	20.1
P. marocaine	Weight 100 olives	429.0	437.4	445.2	462.4	461.1	463.1
	Weight flesh 100 olives	367.5	370.4	379.8	392.3	389.2	393.9
	Weight 100 stones	61.5	67.0	65.4	70.1	71.9	69.1

2.2. Assessed by the Soxhlet method

Table 5 lists the changes in oil content relative to fresh weight in the three varieties. Analysis of variance revealed that variety has an effect on oil content.

Oil content (% FW) increased with fruit ripening, rising from 17.93 to 25.69% for Arbequina, from 17.43 to 24.08% for Koroneiki and from 16.2 to 21.84% for Picholine marocaine.

A strong correlation was observed between oil content (% FW) and the maturity index for all three varieties (Figure 1). The relationship is logarithmic, and is best described by the following equations:

- Arbequina: $Y = 8.2863Ln(x) + 12.216$ with $R^2 = 0.98$
- Koroneiki: $Y = 6.739Ln(x) + 13.743$ with $R^2 = 0.91$
- Picholine marocaine: $Y = 6.875Ln(x) + 12.348$ with $R^2=0.97$

3. Polyphenols

Table 6 reports the polyphenol content of the three varieties, for which the maximum levels were recorded in all three cases between 26 November and 16 December. Analysis of variance revealed that variety has an effect on polyphenols content. Hence, Koroneiki recorded the highest content (2192 ppm), followed by Picholine marocaine (2113 ppm) and Arbequina (1823 ppm). Total polyphenols content (tannic acid) is very strongly correlated with maturity index in the three varieties (Figure 2). This relationship is polynomial and is best described by the following equations:

- Arbequina: $Y = -42.747 x^2 + 287.59 x + 1336.9$ with $R^2 = 0.96$
- Koroneiki: $Y = -200.64 x^2 + 1206.6 x + 288,3$ with $R^2 = 0.97$
- Picholine marocaine: $Y = -152.19 x^2 + 1016.6 x + 517.82$ with $R^2=0.97$

IV. Determination of optimal harvest stage

The accumulation of oil and total polyphenols in the olive fruits was investigated in order to evaluate the optimal harvest date. Polyphenols content is high at the semi-black stage of maturity ($3 \leq MI \leq 4$) after which it starts to decrease while oil content increases.

The approach taken was to identify the point where these two parameters intersect to give a good yield of more stable oil of good organoleptic quality. Using total polyphenols as an indicator for determining the optimal harvest date is a reliable method and affords the following advantages:

- Optimal polyphenols content ensures good oil stability
- The aroma components of the oil vary according to fruit ripening in the same way as the phenolic compounds
- Phenolic compounds are natural antioxidants

TABLE 4
Changes in oil content (% DM) of three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year, determined by nuclear magnetic resonance

Variety	Sampling date					
	13/11/07	19/11/07	26/11/07	16/12/07	24/12/07	07/01/08
Arbequina	40	45	50	52	52	52
Koroneiki	42	44	46	48	50	50
Picholine marocaine	38	40	42	44	46	46

TABLE 5
Changes in oil content (% FM) of three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

Variety	Sampling date					
	13/11/07	19/11/07	26/11/07	16/12/07	24/12/07	07/01/08
Arbequina	17.9 a	20.1 a	21.5 a	23.1 a	25.4 a	25.7 a
Koroneiki	17.4 ab	20.1 a	20.9 ab	22.1ab	23.9 b	24.1 b
Picholine marocaine	16.2 b	17.7 b	19.5 b	20.5 b	21.3 c	21.8 c

and have attracted interest in recent years in relation to ageing and atherosclerosis.

The combination of three criteria used to define the maturity index can be applied to achieve the best compromise between polyphenols content and oil content (Figures 3, 4 and 5). In the case of the varieties studied in the Settat region, harvest can start when the maturity index reaches 2.89 for Arbequina (between 2.89 and 3.93), 2.70 for Koroneiki (between 2.70 and 3.61) and 2.60 for Picholine marocaine (between 2.59 and 3.23). It is recommended to harvest the olives before the maturity index exceeds 4 because above this ceiling polyphenols content starts to decrease significantly in the olives. For the crop year concerned, the optimal harvest period was between 26 November and 16 December, and at the very limit, up to 24 December. After this date, polyphenols content falls substantially and might have a negative impact on subsequent oil stability.

The optimal time to harvest the three varieties studied in the Settat region is when the maturity index lies between 2.89 and 3.93 for Arbequina, 2.70 and 3.61 for Koroneinki and 2.59 and 3.23 for Picholine marocaine (Table 7). In the test plots the olives were harvested between 04/12/07 and 26/12/07, which is well within the optimal harvest period determined according to measurable objective criteria (Table 7). The average yields recorded for the selected trees were 42 kg for Picholine marocaine, 35.7 kg for Arbequina and 33.4 kg for Koroneiki. These differences in yield can be explained by the differences in varietal vigour and age.

V. Stability of the olive oils obtained from the three varieties

The effect of variety on the oxidative stability of the olive oils was assessed. This is defined as the number of days it takes for the oil, when

TABLE 6
Changes in polyphenols content of three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

Variety	Polyphenols (ppm) in fruit flesh					
	13/11/07	19/11/07	26/11/07	16/12/07	24/12/07	07/01/08
Arbequina	1754 b	1778.7 c	1823 c	1807.8 c	1726.1 c	1689.5 b
Koroneiki	1926.5 a	2053.9 a	2178.2 a	2191.5 a	2076.6 a	1861.3 a
Picholine marocaine	1838 ab	1960.5 b	2057.9 b	2112.7 b	1978.3 b	1854.34 a

Figure 2. Relationship between maturity index and total polyphenols content (tannic acid) in three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

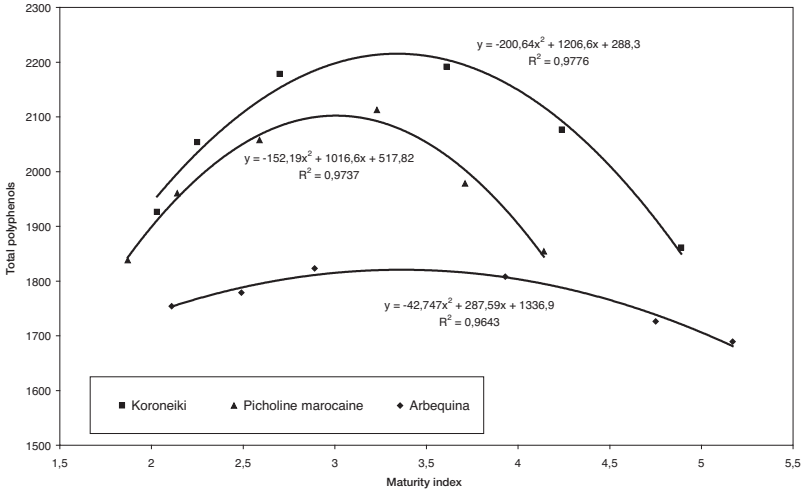


Figure 3. Changes in the maturity index (MI), oil content (%FW) and phenolics content (ppm) of Arbequina olives cultivated in the Settat region (Morocco) in the 2007/08 crop year

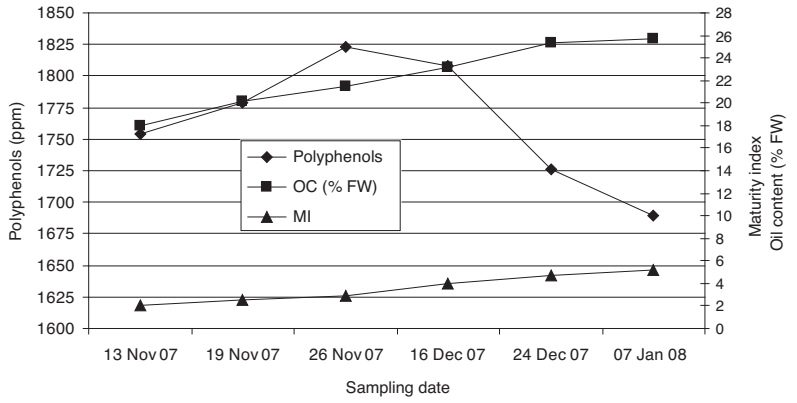
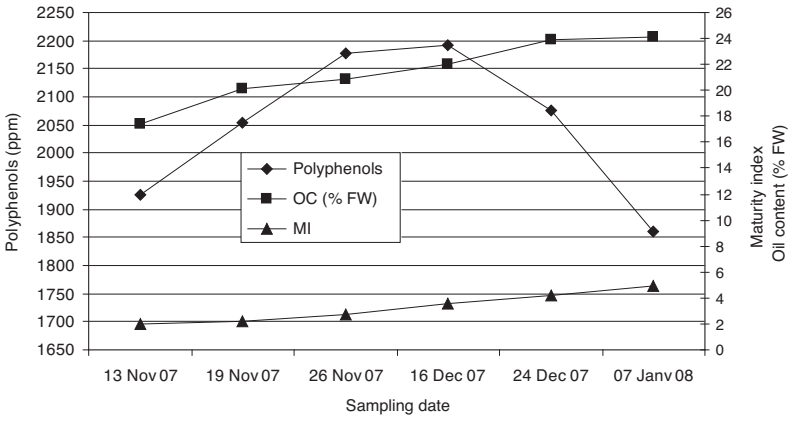


Figure 4. Changes in the maturity index (MI), oil content (%FW) and phenolics content (ppm) of Koroneiki olives cultivated in the Settat region (Morocco) in the 2007/08 crop year



stored in the dark at ambient temperature, to reach a peroxide value of 20 meq O_2/kg or more, which is the limit for olive oils to be considered fresh. The olive oil was extracted in modern facilities and stored in the dark at ambient temperature. The changes in the physico–chemical characteristics of the oils were tracked during storage. The oxidative status was determined by monitoring the acidity, peroxide value, polyphenols content and conjugated dienes at 232 and 270 nm.

1. Changes in acidity

Acidity changed in a similar manner in the three varieties during storage (Table 8). Analysis of variance of the values recorded for the acidity showed that variety exerts an effect on this parameter, which increased from 0.381 to 1.455 for Arbequina, from 0.225 to 1.205 for Koroneiki and from 0.24 to 1.19 for Picholine marocaine. The Arbequina oil had the highest initial level of acidity. In the three cases, acidity rose considerably by 282, 435 and 395%, respectively.

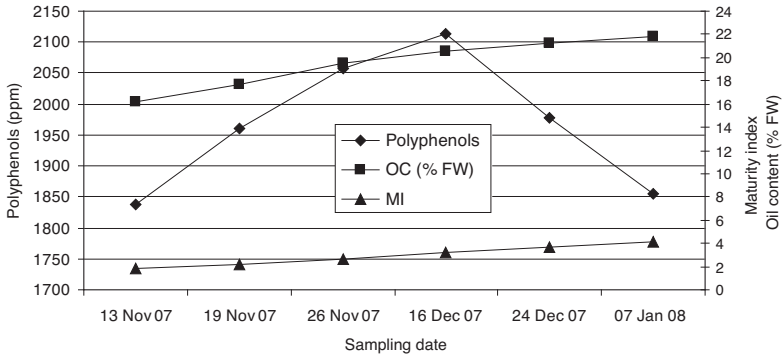
The free acidity of the oil exceeded the 0.8 limit fixed in the IOC trade standard (extra virgin olive oil) in the case of the oil obtained from the Arbequina, Koroneiki and Picholine marocaine after being stored for 102, 128 and 135 days, respectively.

2. Changes in UV absorbance

Oxidation in olive oil leads to the formation of linoleic acid hydroperoxides. These are conjugated dienes which absorb at around 232 nm. If oxidation continues, secondary oxidation products are formed, in particular unsaturated alpha ketones, which absorb at around 270 nm. Hence, the absorbance at these two wavelengths provides information on the oxidative status of olive oils.

The results for the extinction values at 232 and 270 m for the olive oil sampled stored at ambient temperature in the dark are reported in Table 9. Analysis of variance at 232 nm and 270 nm shows variety to exert a significant effect (α=0.05). The absorbance at 232 nm of the Arbequina, Koroneki and Picholine marocaine oil increased from 1.6 to 2.3, from 1.4 to 2.2 and from 1.5 to 2.3, respectively while the absorbance at 270 nm went up from 0.13 to 0.28, from 0.09 to 0.203 and from 0.09 to 0.209. Hence, respective increases of 40, 50 and 51% were recorded in the absorbance at 232 nm and of 111, 115 and 122% in that at 270 nm. The rate of increase in absorbance was therefore similar for the three varieties. Inter-varietal differences were in the initial levels as opposed to in the speed of formation (Table 9).

Figure 5. Changes in the maturity index (MI), oil content (%FW) and phenolics content (ppm) of Picholine marocaine olives cultivated in the Settat region (Morocco) in the 2007/08 crop year



The extinction values increased with storage time. The induction stage lasted from 75 to 100 days. The small change in the extinction values during the initiation stage is due to the high oleic acid content of olive oil which, when oxidised, only produces unconjugated hydroperoxides. After the first stage, the increase is greater.

The results obtained for the absorbance values of the three varieties at 232 nm and 270 nm comply with the IOC

TABLE 7
Changes in the polyphenols content, oil content (%FW) and maturity index of three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

Sampling date	Arbequina			Koroneiki			Picholine marocaine		
	Polyphenols	OC[1] (% FW[2])	MI[3]	Polyphenols	OC (% FW)	MI	Polyphenols	OC (% FW)	MI
13/11/07	1 754	17.93	2.11	1 926.5	17.43	2.03	1 838.0	16.2	1.87
19/11/07	1 778.7	20.1	2.49	2 053.9	20.15	2.25	1 960.5	17.68	2.14
26/11/07	**1 823.0**	21.5	2.89	**2 178.2**	20.9	2.70	**2 057.9**	19.47	2.59
16/12/07	**1 807.8**	23.135	3.93	**2 191.5**	22.03	3.61	**2 112.7**	20.515	3.23
24/12/07	1 726.1	**25.35**	4.75	2 076.6	**23.88**	4.24	1 978.3	**21.3**	3.71
07/01/08	1 689.5	25.69	5.17	1 861.3	24.08	4.89	1 854.34	21.84	4.14

[1] oil content, [2] fresh weight, [3] maturity index

TABLE 8
Changes in free acidity during storage of the oil produced from three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

Variety	Free acidity[1] during storage (d)				
	45 d	75 d	105 d	135 d	165 d
Arbequina	0.381 a	0.538 a	0.858 a	1.285 a	1.455 a
Koroneiki	0.225 b	0.385 b	0.540 b	0.920 b	1.205 ab
Picholine marocaine	0.240 b	0.390 b	0.660 b	0.815 b	1.190 b

[1] g oleic acid/100 g

standard and are below the thresholds of 2.6 and 0.25 fixed in the standard.

3. Changes in polyphenols content

The Koroneiki oil had a higher initial polyphenols content than the Picholine marocaine, which was richer in polyphenols than the Arbequina oil. Table 10 reports the changes in polyphenols during storage. Analysis of variance shows that variety has a very significant effect on polyphenols content (α = 0.001), which went from 273.5 to 69 in Arbequina, from 504 to 152 in Koroneiki and from 404 to106 in Picholine marocaine, which translates into a respective decrease of 75, 70 and 74%. Hence, the rate of decrease in polyphenols content was similar for all three varieties. The differences between varieties were observed in the starting levels of polyphenols as opposed to in their rate of degradation.

4. Changes in peroxide value

Olive oils lose their freshness as of a peroxide value of 20 meq O_2 /kg or higher. The peroxide value was determined in samples

TABLE 9
Changes in the absorbance at 232 nm and 270 nm of the oil produced from three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

Variety		Changes in UV absorbance				
		45 days	75 days	105 days	135 days	165 days
Arbequina	E_{232}	1.664 ±0.0127 **a**	1.718 ± 0.0106 **a**	1.995 ± 0.106 **a**	2.219 ± 0.066 **a**	2.335 ± 0.220 **a**
	E_{270}	0.134 ± 0.003 **α**	0.152 ± 0.010 **α**	0.220 ± 0.011 **α**	0.250 ± 0.019 **α**	0.283 ± 0.005 **α**
Koroneiki	E_{232}	1.448 ± 0.240 **b**	1.522 ± 0.0141 **b**	1.635 ± 0.030 **b**	2.021 ± 0.129 **a**	2.181 ± 0.692 **a**
	E_{270}	0.094 ± 0.002 **β**	0.112 ± 0.0042 **β**	0.154 ± 0.003 **β**	0.181 ± 0.028 **β**	0.203 ± 0.012 **β**
P. marocaine	E_{232}	1.528 ± 0.024 **b**	1.669 ± 0.062 **ab**	1.973 ± 0.005 **a**	2.215 ± 0.019 **a**	2.314 ± 0.024 **a**
	E_{270}	0.094 ± 0.002 **β**	0.113 ± 0.005 **β**	0.149 ± 0.003 **β**	0.195 ± 0.003 **β**	0.209 ± 0.005 **β**

TABLE 10
Changes in polyphenols content during storage of the oil produced from three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

Variety	Polyphenols content (ppm) during storage (d)				
	45 d	75 d	105 d	135 d	165 d
Arbequina	273.5 c	243.6 c	162.3 c	126.5 b	69.1 c
Koroneiki	504.0 a	455.0 a	361.5 a	220.3 a	152.0 a
Picholine marocaine	404.0 b	363.0 b	262.3 b	166.0 b	106.0 b

collected at regular 30-day intervals from oils stored in darkness at ambient temperature.

The changes in peroxide value during storage of the three varieties of oil are given in Table 11. Analysis of variance shows variety to have a highly significant effect (α=0.01).

After three months' storage, the peroxide value rose from 9.3 to 23.9 in Arbequina, from 7.1 to 20.8 in Koroneiki and from 7.2 to 22.1 in Picholine marocaine. Hence, it increased by 158, 197 and 212% respectively in the three varieties of oil. The peroxide value overstepped the limit of 20 meq O_2/kg oil fixed in the standard after the oil was stored for 113, 143 and 155 days respectively for the Arbequina, Koroneiki and Picholine marocaine oil. Consequently, the Arbequina oil is less stable than the Picholine marocaine oil, which in turn is less stable than the oil produced from the Koroneiki variety.

CONCLUSIONS

In this study we evaluated the performance of the Arbequina, Koroneiki and Picholine marocaine varieties in the region of Settat (Morocco). To do so, we determined the carpometric characteristics, moisture content, oil content (% FW and %DW), polyphenols content and harvest date. Upon review, the changes in the maturity index revealed that in the soil/climatic conditions of the orchard and in the crop year concerned, the Arbequina olives ripened earlier than the Koroneiki variety, which was slightly earlier than Picholine marocaine. The values for moisture content show that Picholine marocaine had the highest content, followed by Arbequina and finally by Koroneiki with a low content. The Arbequina and Koroneiki varieties gave higher oil yields, with contents going from 17.93 to 25.69 (%FW) and from 17.43 to 24.08 (%FW) respectively compared with Picholine marocaine for which the content went from 16.2 to 21.84 (%FW).

The top polyphenol contents were recorded between

TABLE 11
Changes in peroxide value during storage of the oil produced from three varieties of olive cultivated in the Settat region (Morocco) in the 2007/08 crop year

Variety	Peroxide value during storage (d)				
	45 d	75 d	105 d	135 d	165 d
Arbequina	9.3 a	12.5 a	16.4 a	22.2 a	23.9 a
Koroneiki	7.1 b	9.6 b	14.6 b	18.3 c	20.8 b
Picholine marocaine	7.2 b	10.8 b	15.1 b	19.3 b	22.1 b

26 November and 16 December for the three varieties. Koroneiki recorded the highes level at 2 192 ppm, followed by Picholine marocaine with 2 113 ppm and Arbequina in last place with 1 823 ppm. The combination of criteria applied to determine the optimal harvest date revealed that harvest can start in the Settat region when the maturity index reaches 2.89 for Arbequina (between 2.89 and 3.93), 2.70 for Koroneiki (between 2.70 and 3.61) and 2.60 (between 2.59 and 3.23) for Picholine marocaine.

Variety has a significant effect on the physico–chemical characteristics of peroxide value, free acidity, total polyphenols and UV absorbance at 232 and 270 nm, thus showing that oil stability is variety-dependent. More specifically, the changes in the physico–chemical characteristics of the oils, notably peroxide value, shows that the Arbequina produces less stable oils (113 days) than do Picholine marocaine (143 days) and (155 days). ■

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