Mediterranean forest ecosystems: better value NWFPs for conserving resources

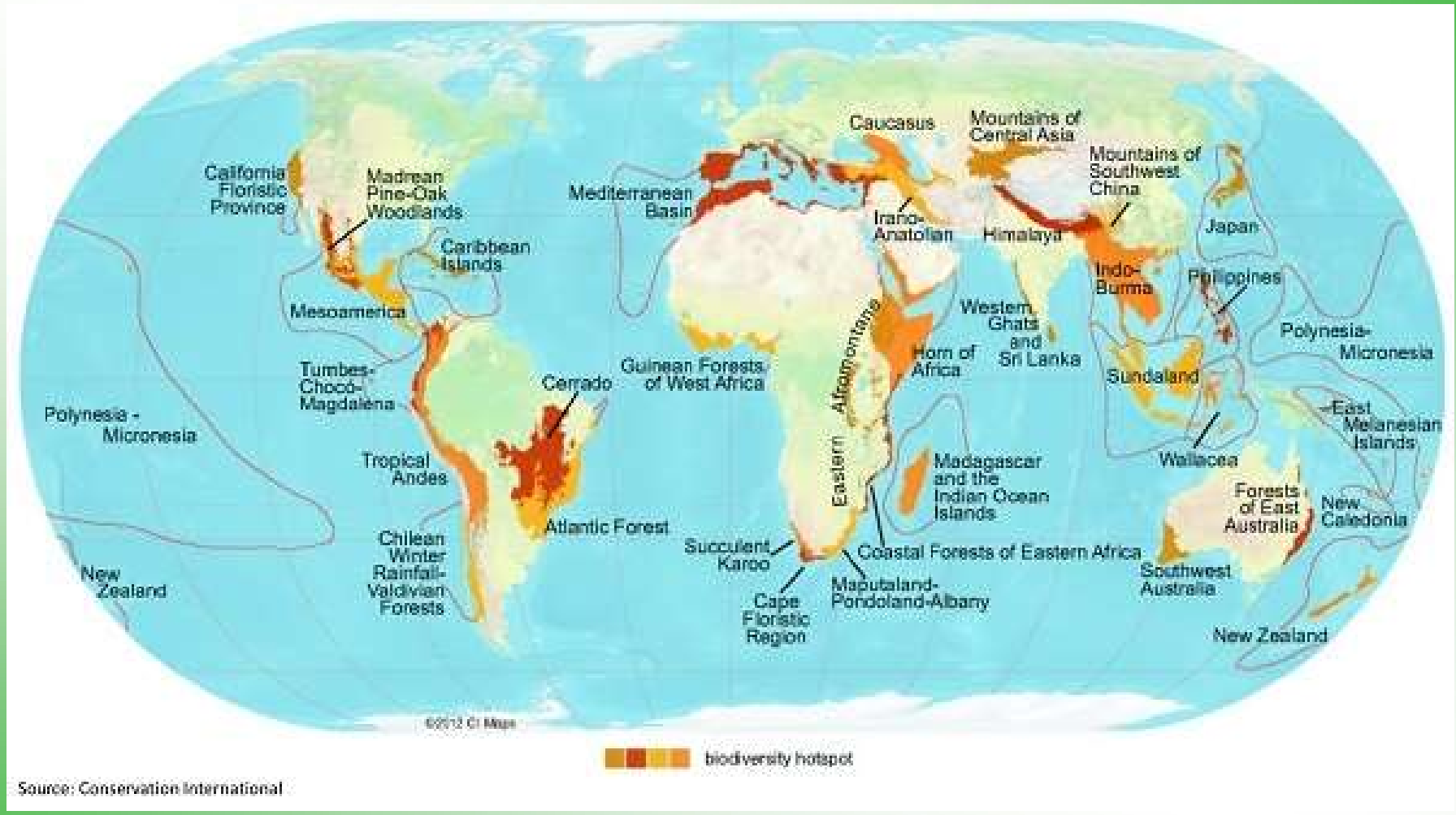
Abdelhamid Khaldi

INRGREF

- Introduction
- Mediterranean forests: goods and services not always known and recognized
- Conserving biodiversity and restoring landscapes: is it enough?
- Valuing to preserve is it a reliable concept or utopia?
- NTFPs, natural products from Mediterranean forest formations serving societies
- Examples of valuation to conserve forest resources
- Conclusion

- **Introduction**

The Mediterranean forest formations contain a great biological diversity and therefore offer several types of natural products.



Source: Conservation International

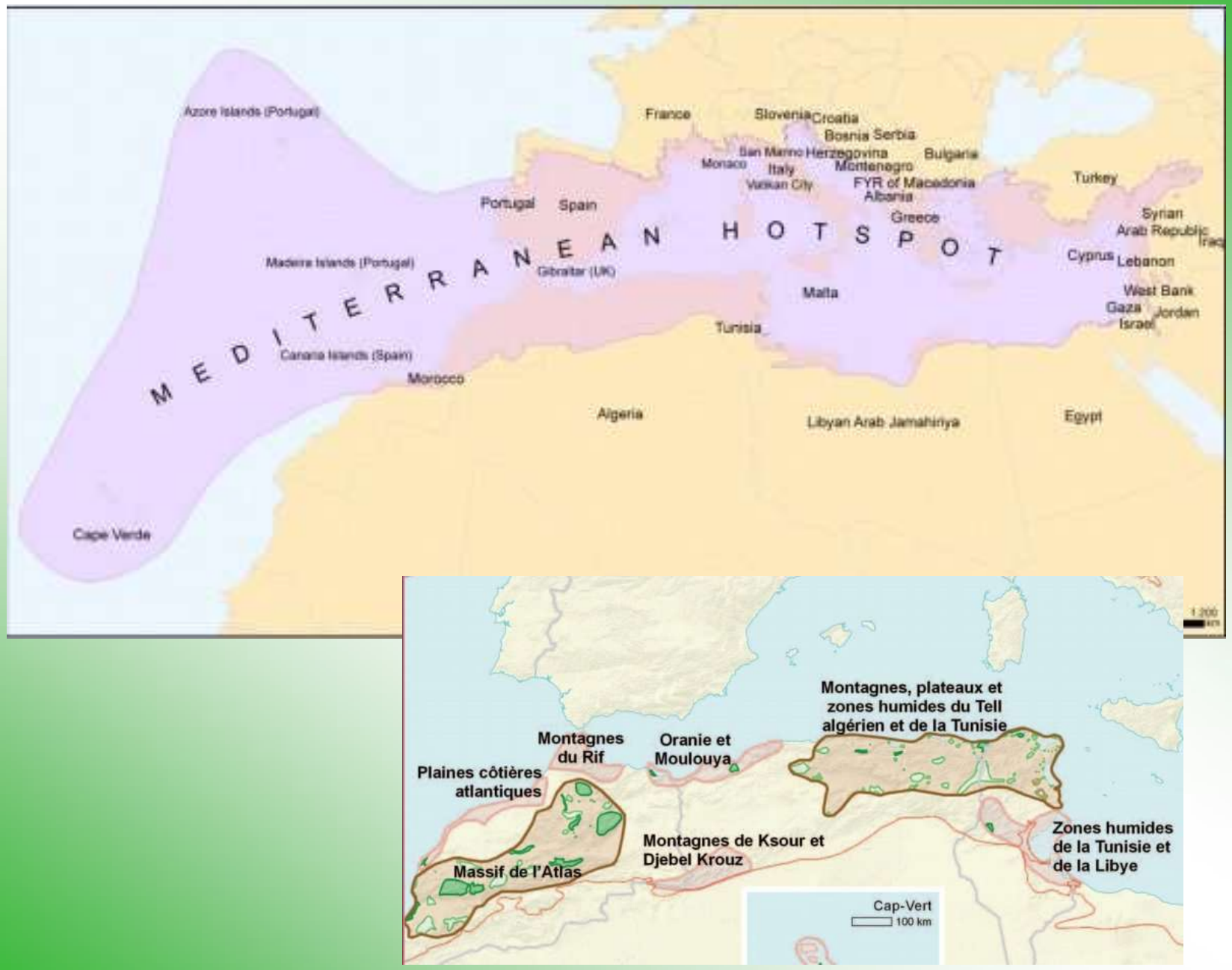
Mediterranean terrestrial ecosystems and biodiversity

A great diversity of plants and animals with a high rate of endemism

- Flora
- Wildlife
- endemism

- 22500 species of vascular plants of which about 11700 (52%) endemic.
- Important rate of endemism in trees (290 tree species including 201 endemic: Lebanon cedar, argan tree, cork oak, ...
- 10 mini hotspots: ex. Atlas mountains in North Africa,
- These ten areas cover about **22%** of the total area of the basin, but are home to nearly 5,500 endemic plant species, that is, about **47%** of the total Mediterranean endemic species.

From: http://www.conservation-nature.fr/article1.php?id=93#



Abdelhamid Khaldi - INRGREF

- **Mediterranean forests: goods and services not always known and recognized**

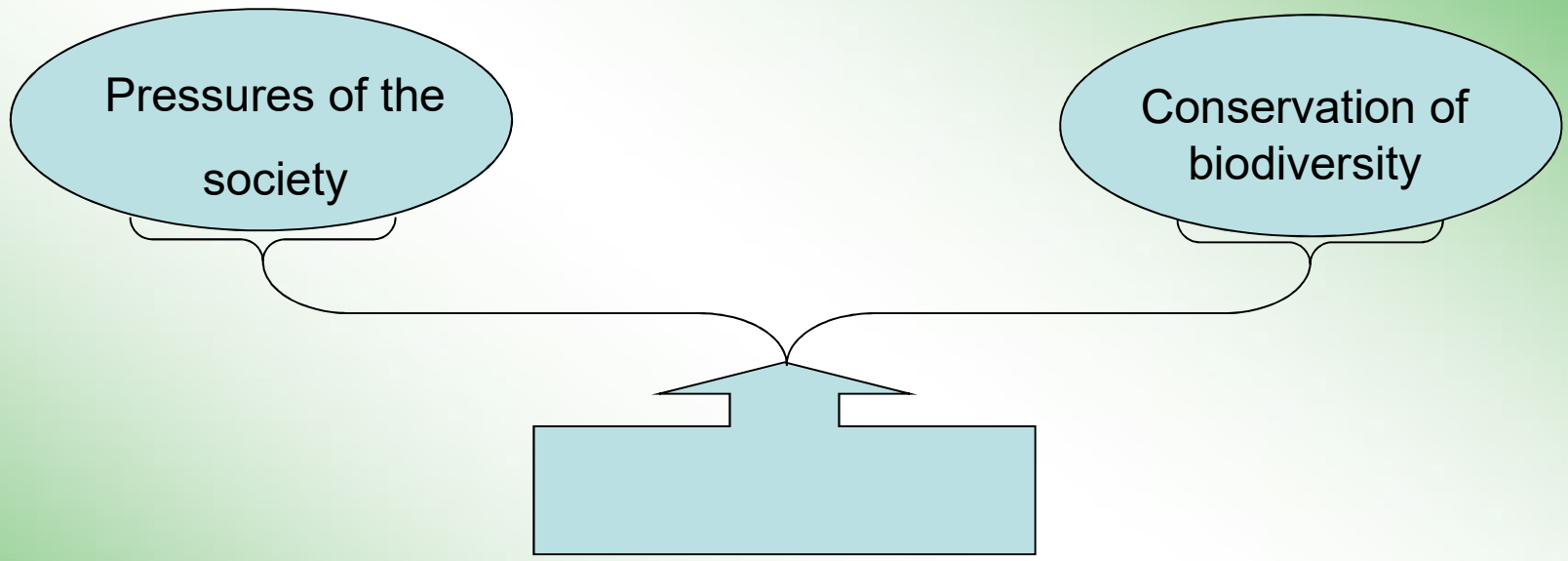
Diversity of goods and services offered by Mediterranean forest ecosystems to society and particularly to communities in forest areas

- Productions of goods:
  - Wood for industry and other uses, firewood, cork
  - NWFP (animal production from (silvopastoaralism, hunting, honey, mushrooms ...),
- Services provided to the societies :
  - Water quality (storage and filtration)
  - Protection against erosion, desertification and avalanches
  - Air quality
  - Carbon sequestration,
  - Preservation of biodiversity (flora and fauna)
  - Popular landscapes
  - Ecotourism and recreational activities

- **Conserving biodiversity and restoring landscapes: is it enough for sustainability?**

- Protected areas (NP, NR, protected habitats, ...): limited areas, strategic importance but is it sufficient?

Valuing to better preserve?



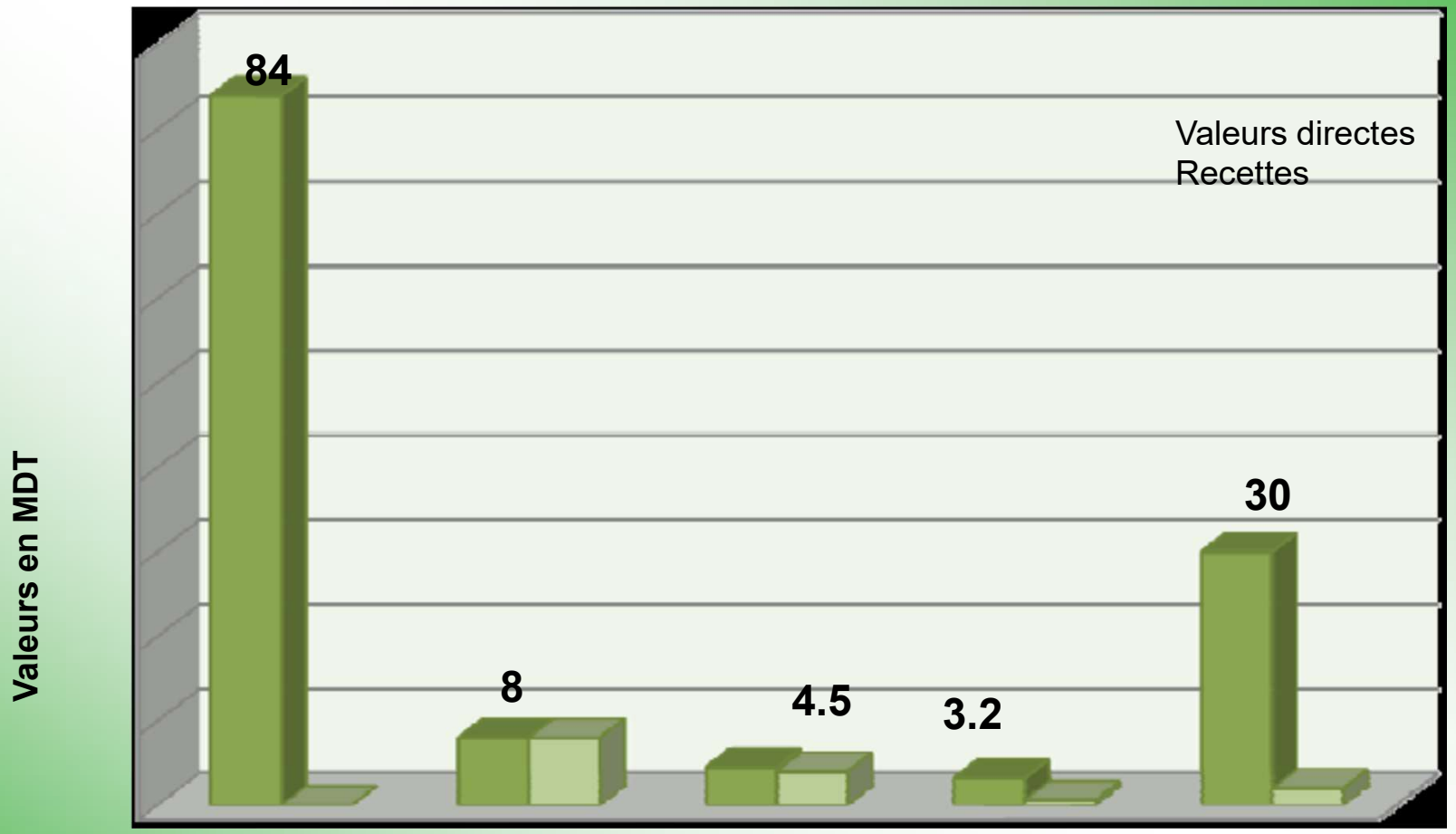
Valuate = exploit (sustainably)

- **NWFPs, natural products from Mediterranean forest ecosystems serving the societies**

- ✓ Terroir products are becoming more and more popular around the world and are becoming an important economic issue.
- ✓ The ecological and biological specificities of natural products can give them a valuable originality.

- ✓ Non-Wood Forest Products (NWFPs), often called - wrongly - secondary forest products, are numerous and sometimes represent significant sources of income for the inhabitants in the forest areas.
- ✓ Among these products, some are known and exploited, others little known and which would be better valued and there are those that are not yet valued and for which there is a need for concrete initiatives.

Not only wood as production !



Source: Saadani 2010

➢Known and exploited products
Alfa (*Stipa tenacissima*)

➢Known and exploited products

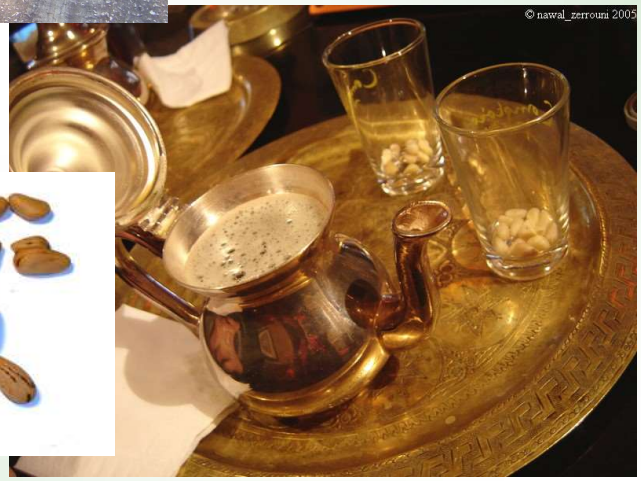
Cork

➢Known and exploited products

Seeds of Aleppo pine (Pinus halepensis) called (Zgougou)

➢Know and exploited products

Seeds of the stone pine (pine nuts): a highly valued resource but resource management better improvable



- **Known and exploited products**
- **Capers : essentially for food use**

remains to be valued: caper berries

Abdelhamid Khaldi - INRGREF

➢Known and exploited products
➢Rosemary :

- Quality
- Resource management

Essential oil; mainly medicinal and aromatic use

- **Known and exploited products**
- **Myrtle biomass:**

Essential oil; mainly medicinal and aromatic use

➢Known and exploited products

➢ Mushrooms

Most common edible mushrooms :
Chanterelles (*Cantharellus cibarius*),
Yellow chanterelles (*Cantharellus lutescens*),
Sheep feet (*Hydnum repandum*)
Ceps or boletus mushrooms (*Boletus edulis*).

➢Known and exploited products

Honey

The most important quantities come mainly from Eucalyptus forests and rosemary and thyme

➢Known and exploited products
Hunting production

➢Known and exploited products
Snails

The two most collected and marketed species are:
Helix melanostoma: gray and large with globular she
Eobania vermiculata: with striated shells.
The most sought after snails for export are the grays

Source : DGF, 1997

➢Little known and better valued products
Cork oak acorns

current use: mainly as fodder

- Collecting and regeneration

- **Little known and better valued products**
  Carob pods and seeds

Use as condiments, medicinal and food industry (thickening additive)

➢Little known and better valued products
Fixed oil of lentisk (*Pistacia lentiscus*)

use in traditional medicine

- **Little known and better valued products**
  Penny mint (distillation)

Therapeutic use

➢Little known and better valued products

Distillation of other species: example of Eucalyptus

The populations of the forest areas have a know-how in the extraction of these oils by artisanal processes or improved especially for their own uses.

Marketing channels are not organized to sell the products

➢Little known and better valued products
The « bitter » honey

Bitter honey is a typical product of some forest areas, located mainly in the regions of Ain Draham (Tbeïnia), Nefza (Khrogalia) and Sejenane (Kef Abed).
This product, known for its medicinal properties, is sold by producers directly to consumers who often come for it

➢Little known and better valued products

Craft products

Plaiting and basketry and the manufacture of handicrafts from wood (household utensils, decorative objects).

Example of *Ampelodesmos mauritanicus*

Abdelhamid Khaldi - INRGREF

➢**Products not yet valued in Tunisia**

fruits of *Arbutus unedo*)

Resources available, valued in other Mediterranean countries but rarely in Tunisia

➢**Products not yet valued in Tunisia**

myrtle berries (*Myrtus communis)*

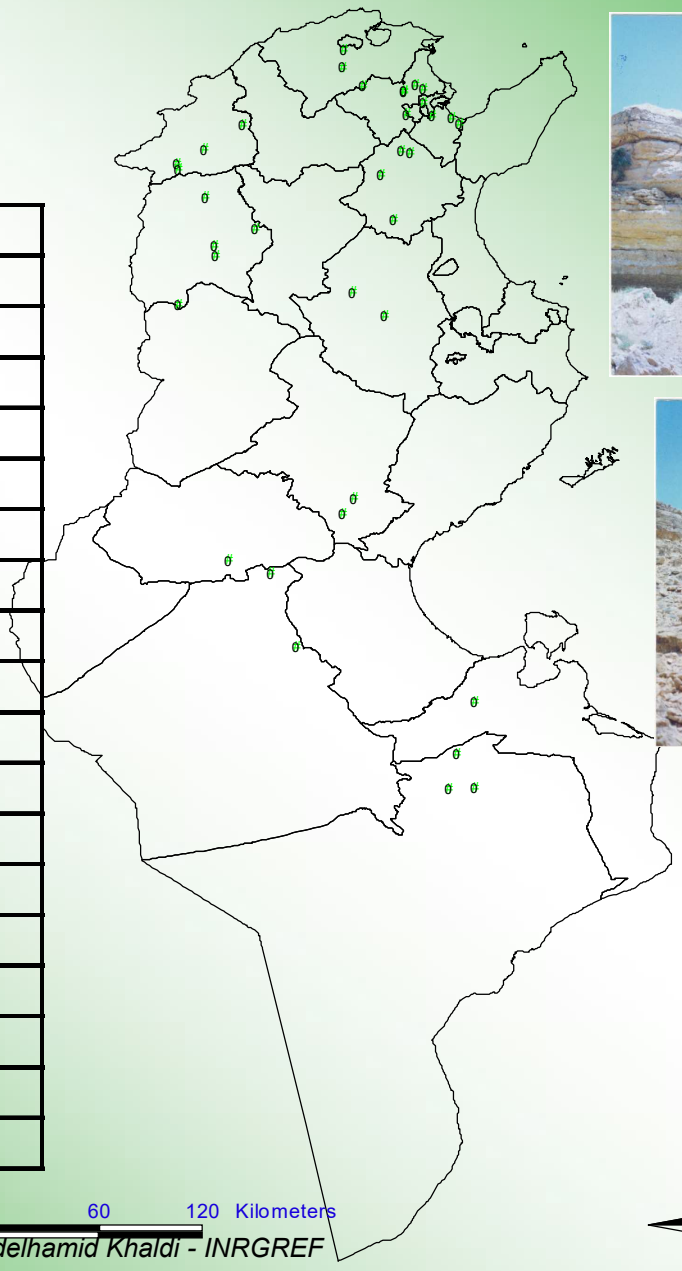
Resources available, valued in other Mediterranean countries but very rarely in Tunisia

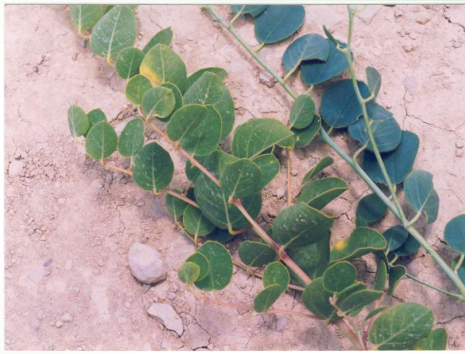
- **Examples of valuation to conserve resources**

- **Diversity of the caper and development of its culture**
- **Valuation and conservation of carob**
- **Valorization of the fixed lentisk oil and change of local perception (conservation concern)**

Distribution sites of the caper in Tunisia

SITES	
Oum ali	Oued Mliz
El Guetar	Chemtou
Chebika	Bullaregia
Dahmani	Bousalem
Dj-Esseria -Dahmani	Bourouis
Gsar Hdada	Sers
Mednine	Ennahli
Cheneni T	Sidi thabet
Tataouin	Mornaguia
Kebili	Dj-El Oust
Borj Cedria	Kalaa Khasba
Boukornine	Aïn Jloula
Dj.Jeloud	Ichkeul
Cité Rommana	Mateur
Chouigui	Maknassi
Dj. Ammar	Bouhedma
Sabbalet Ben Ammar	Bir mecharga
Dj. Essif	Dj. Ben Kleb





Abdelhamid Khaldi - INRGREF

Journal of Herbs, Spices & Medicinal Plants, 15:9–15, 2009
Copyright © Taylor & Francis Group, LLC
ISSN: 1049-6475 print/1540-3580 online
DOI: 10.1080/10496470902787444

Taylor & Francis
Taylor & Francis Group

Intraspecific Variation of *Capparis spinosa* L. in Tunisia

EZZEDDINE SAADAOUI,[1] ABDELHAMID KHALDI,[1]
MOHAMED LARBI KHOUJA,[1] and EL GAZZAH MOHAMED[2]

ELSEVIER

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Original article

Capparis spinosa leaves extract: Source of bioantioxidants with nephroprotective and hepatoprotective effects

CrossMark

Nizar Tlili[a,d,*], Anouar Feriani[b,c], Ezzeddine Saadoui[d], Nizar Nasri[a], Abdelhamid Khaldi[d]

[a] Laboratoire de biochimie, Faculté des Sciences de Tunis, Université Tunis El-Manar, 2092 Tunis, Tunisie
[b] Unité de Biochimie Macromoléculaire et Génétique, Faculté des Sciences de Gafsa, cité Zarroug, Université de Gafsa, 2112 Gafsa, Tunisie
[c] Laboratoire d'Ecophysiologie Animale, Faculté des Sciences de Sfax, Tunisia
[d] Institut National de Recherches en Génie Rural, Eaux et Forêts, Université de Carthage, BP 10, Ariana 2080, Tunisie

ARTICLE INFO ABSTRACT

ELSEVIER

Contents lists available at ScienceDirect

Industrial Crops and Products

journal homepage: www.elsevier.com/locate/indcrop

Phenolic profile and antioxidant activity of *Capparis spinosa* seeds harvested from different wild habitats

CrossMark

Nizar Tlili[a,e,*], Houda Mejri[b], Feriani Anouer[c,d], Ezzeddine Saadaoui[e], Abdelhamid Khaldi[e], Nizar Nasri[a]

ELSEVIER

Contents lists available at ScienceDirect

Food Bioscience

journal homepage: www.elsevier.com

Protective effects of phytochemicals of *Capparis spinosa* seeds with cisplatin and CCl_4 toxicity in mice

Meriam Tir[a, *], Anouar Feriani[b], Arbia Labidi[c], Afoua Mufti[b], Ezzeddine Saadaoui[c], Nizar Nasri[d], Abdelhamid Khaldi[c], Mhammed El Cafsi[a], Nizar Tlili[c, d, **]

[a] UR de Physiologie et Environnement Aquatique, Faculté des Sciences de Tunis, Université Tunis EL Manar, 2092 Tunis, Tunisia
[b] Unité de Biochimie Macromoléculaire et Génétique, Faculté des Sciences de Gafsa, cité Zarroug, Université de Gafsa, 2112 Gafsa, Tunisia
[c] Institut National de Recherches en Génie Rural, Eaux et Forêts, Université de Carthage, Ariana 2080, Tunisia
[d] Laboratoire de Biochimie, Département de Biologie, Faculté des Sciences de Tunis, Université Tunis El-Manar, Tunis 2092, Tunisia

Int.J.Curr.Res.Aca.Rev.2015; 3(1):315-327

EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review
ISSN: 2347-3215 Volume 3 Number 1 (January-2015) pp. 315-327
www.ijcrar.com

Wild Tunisian *Capparis spinosa* L.: Subspecies and Seed Fatty Acids

Ezzeddine Saadaoui[1]*, Arbi Guetat[2], Chokri Massoudi[2], Nizar Tlili[3] and Abdelhamid Khaldi[4]

- Degradation of natural stands and drop in production
- Need for safeguard (culture)

Abdelhamid Khaldi - INRGREF

➢Development of the caper cultivation

Planted material: *C. spinosa* ssp. *rupestris* (less tan 1% of the wild caper)

- Degradation of natural stands and drop in production
- Need for safeguard (culture)

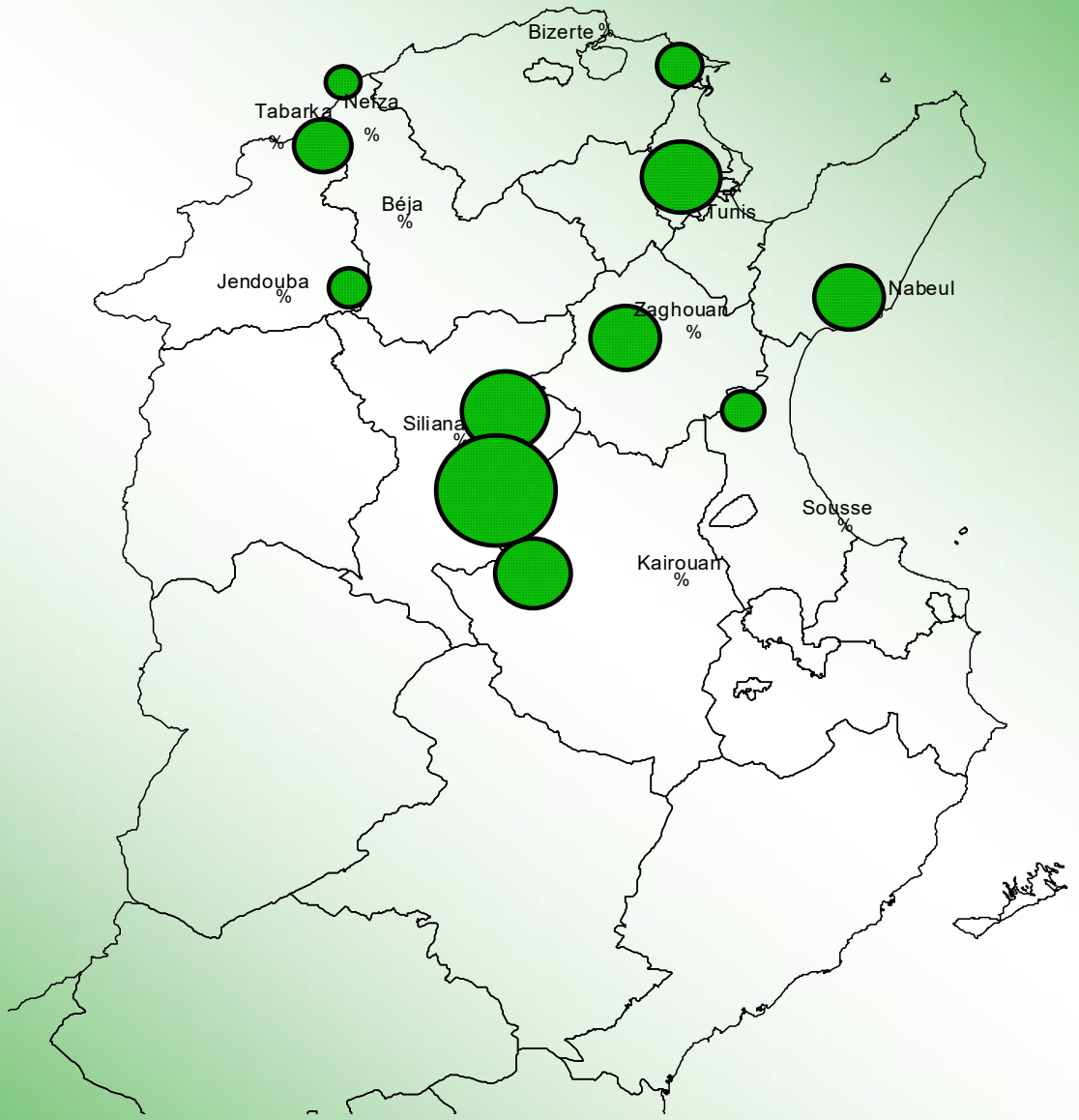
Abdelhamid Khaldi - INRGREF

- **Valuation and conservation of carob tree**

Ecology and distribution

Source: http://arbolesmonumentalestudmiria.blogspot.com/2015/04/garrofero-algarrobo-ceratonia-siliqua.html

Distribution in Tunisia: main stands



Abdelhamid Khaldi - INRGREF

- **The valorization of carob seeds: gum (E410)**
  - **Extracting technology**
  - **Characterization**
  - **Uses (flour pods and gum)**

Large diversity

Abdelhamid Khaldi - INRGREF

Establishment of pod and seed descriptors based on origin sites


1 mm
500 mic
355 mic
160 mic
180 mic


patiwizz
GOMME
DE CAROUBE
Poids net : 1 kg

2

Biochemical Diversity of Wild Carob Tree Populations and Its Economic Value

S. Naghmouchi[1*], M. L. Khouja[1], A. Khaldi[1], M. N. Rejeb[1], S. Zgoulli[2], P. Thonart[2] and M. Boussaid[3]

[1]*Institute of Research in Rural Engineering, Water and Forestry (INRGREF), Tunisia*
[2]*Wallon Centre of Industrial Biology (CWBI). University of Liege Sart Tilman, Liège,*
[3]*National Institute of Applied Science to Technology (INSAT Tunis), Centre Urbain Nord, Tunisia*
[1,3]*Tunis*
[2]*Belgique*

Get Access Share Export

ELSEVIER

Food Chemistry
Volume 101, Issue 4, 2007, Pages 1508-1515

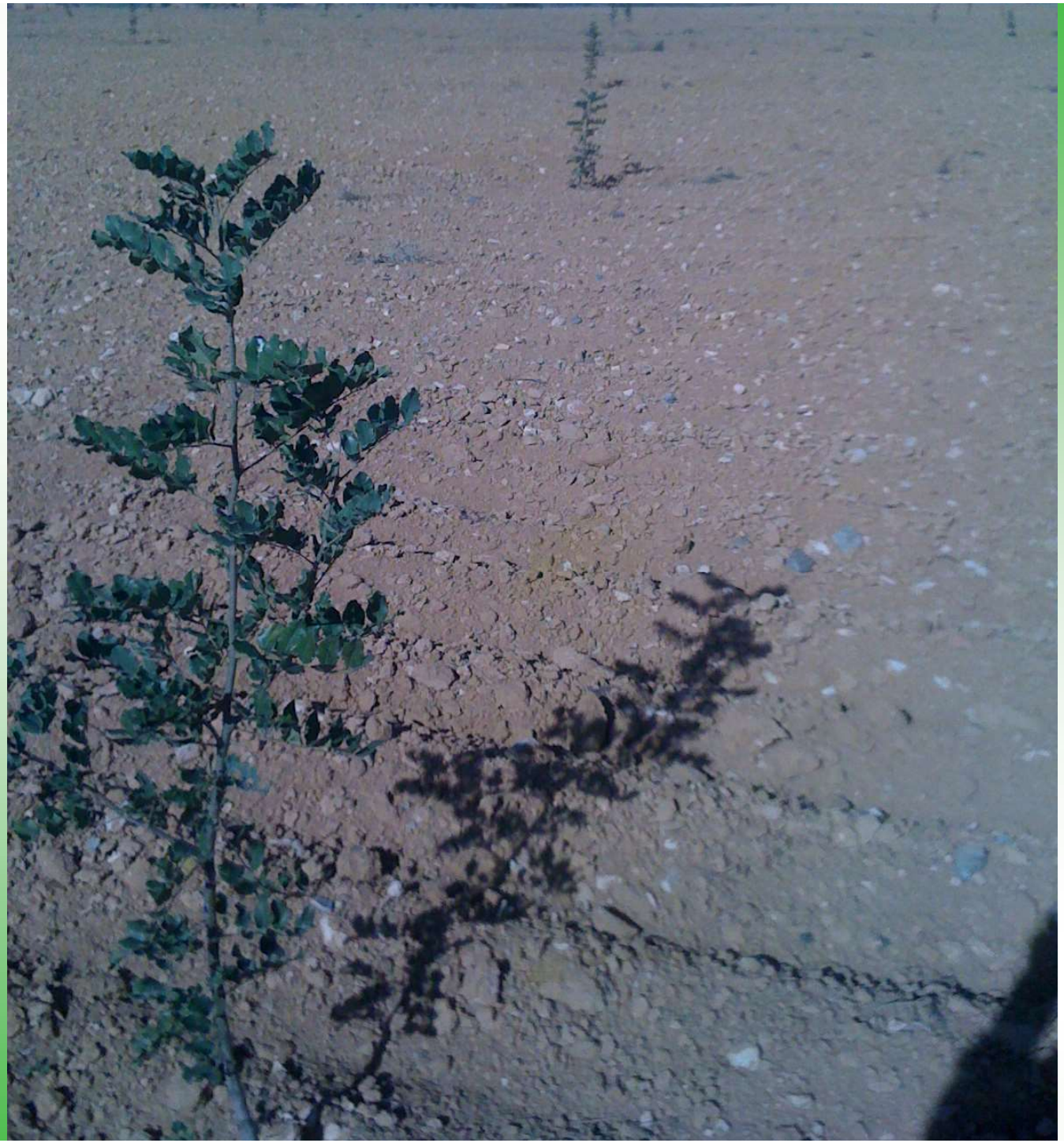
The analysis of crude and purified locust bean gum: A comparison of samples from different carob tree populations in Tunisia

N. Bouzouita [a], A. Khaldi [b], S. Zgoulli [c], L. Chebil [a], R. Chekki [a], M.M. Chaabouni [a], P. Thonart [c]

Show more

https://doi.org/10.1016/j.foodchem.2006.03.056

Get rights and content



➢Experimental plantations of carob

Gfrafting

Grafting in nursery

Abdelhamid Khaldi - INRGREF

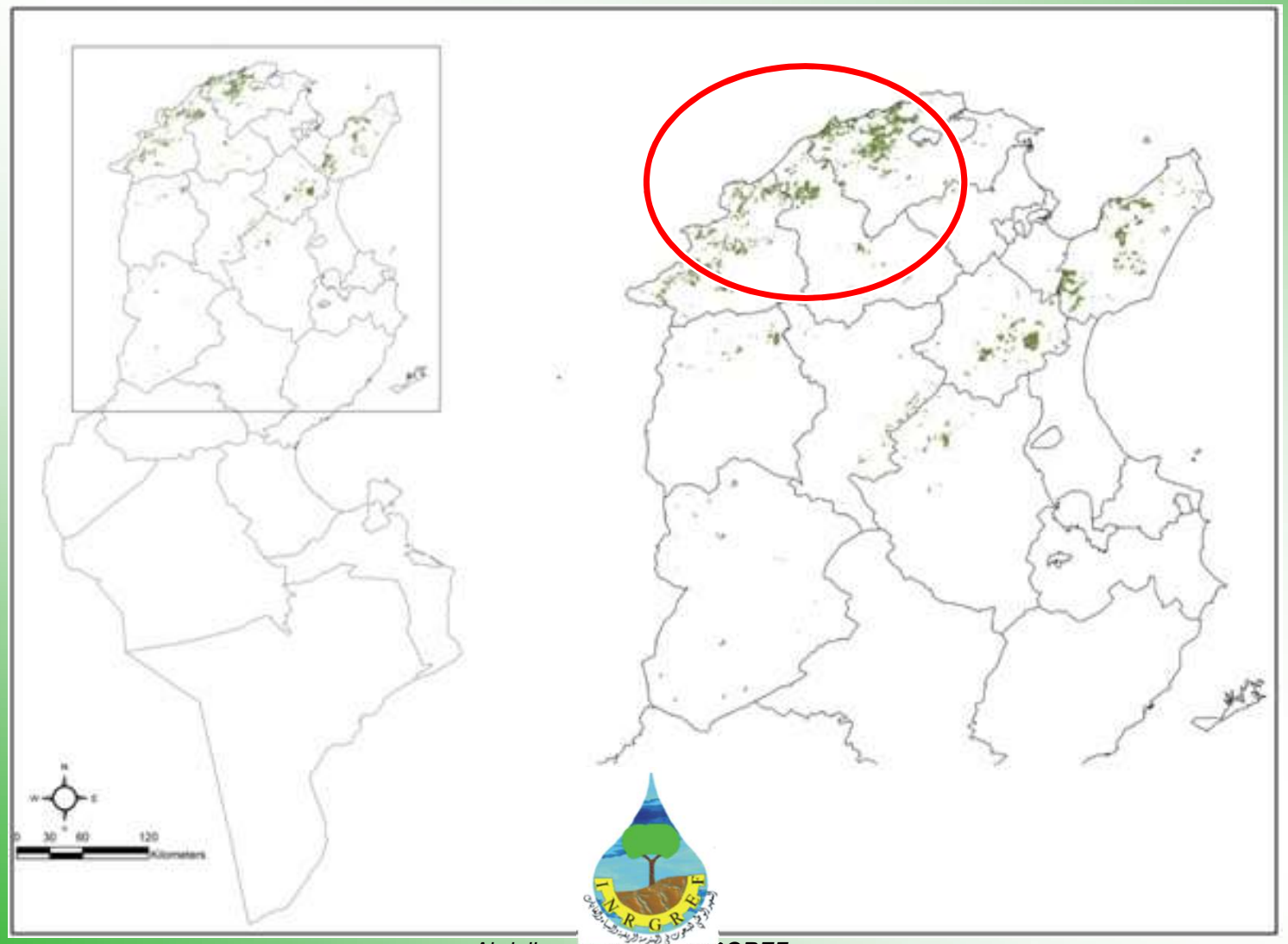
➢Grafting and material selection

- **Valorisation of the fixed lentisque oil and change of perception (conservation concern)**

Pistacia lentiscus L.

Abdelhamid Khaldi - INRGREF

- 69 000 ha



Uses of branches

- Oil uses

traditional method of extraction of fixed oil

Modern method of fixed oil extraction

- Improved oil yield
- Improved oil quality
- More practical and ergonomic
- Save time

- Patented method (Patent registered at INNORPI
- TN2013 / 0181)

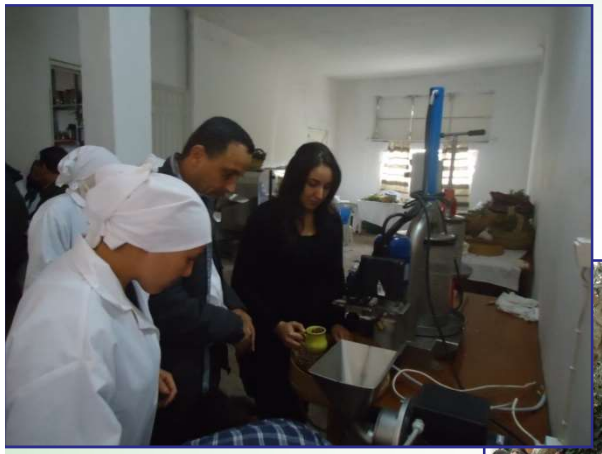
- Patent exploited by industrialists (WM oils ...)

- Revenue improvement:
- 15 TND/liter in 2010 to 120 TDN in 2018

- Demand for this product in the markets has increased.

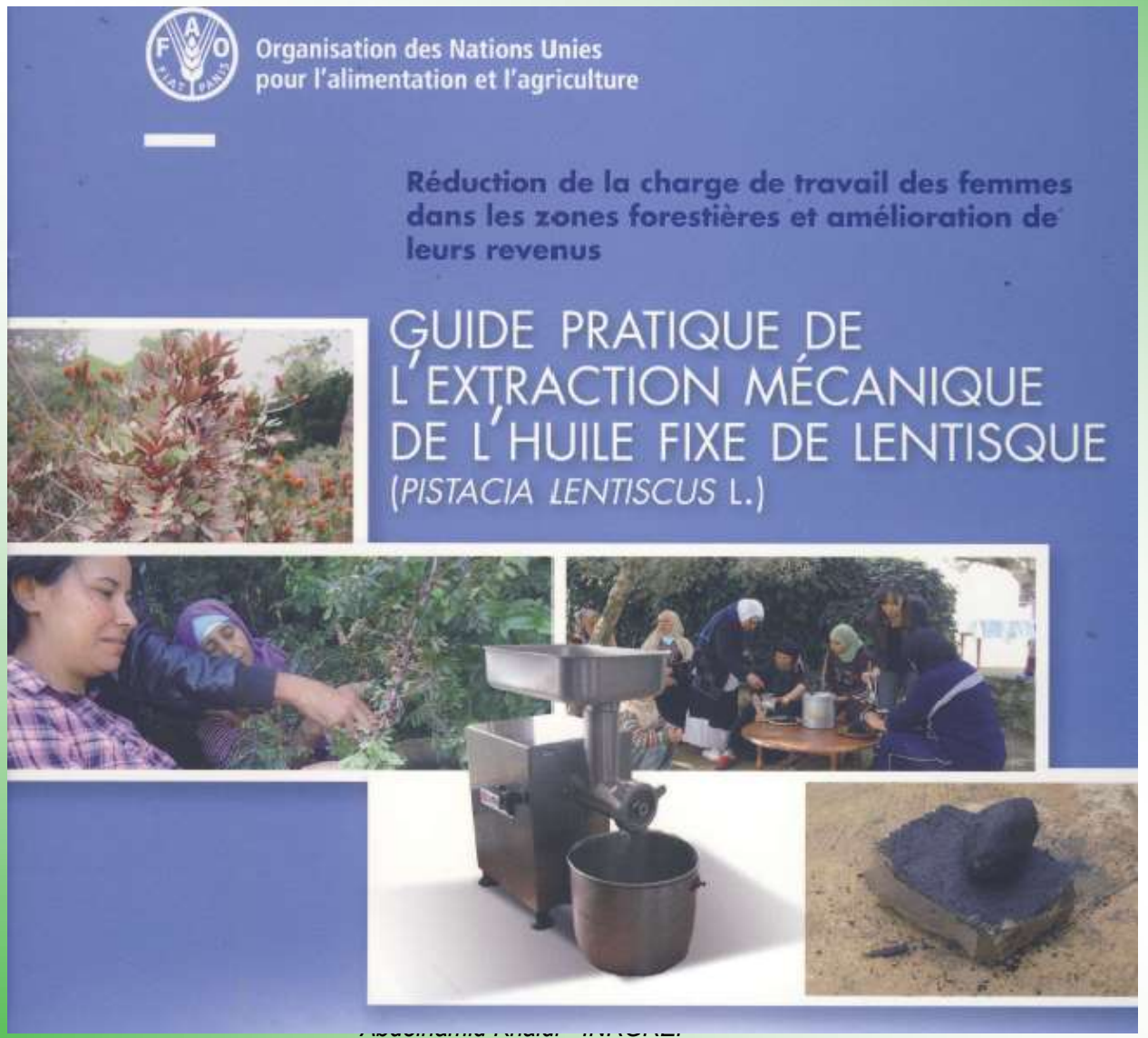
- The rate of production of lentisk oil is estimated at 60 liters per household per year

Practical training sessions in the forest areas

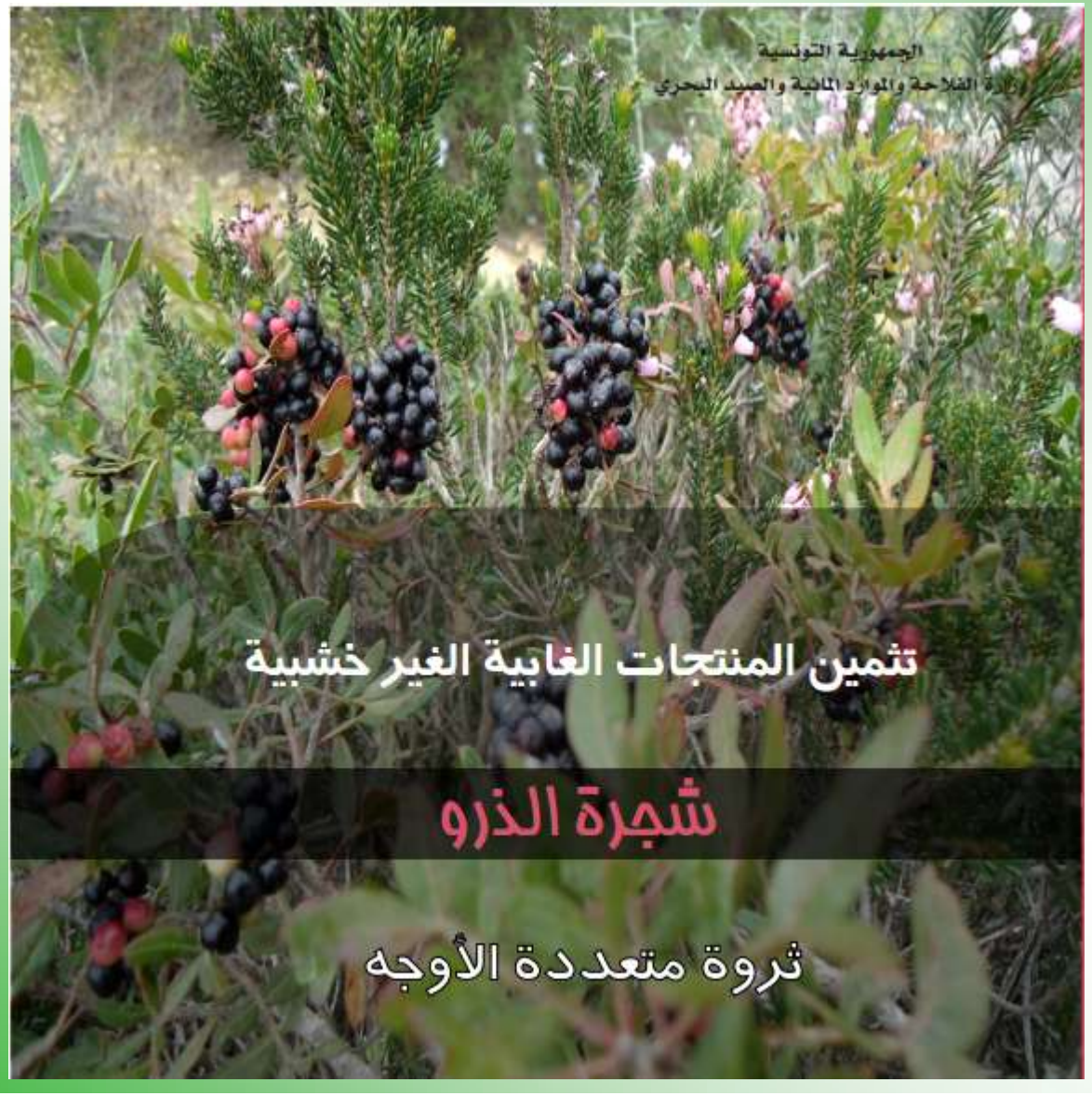


Site	Date of training
Gouairia-Jendouba	1 et 2 Décembre 2010
Oued El Maaden-Béja	22 Décembre 2010
Sidi Amor-Ariana	4 Octobre 2012
Oued Sbeyhia-Zaghouan	6 Novembre 2012
Oued El Maaden-Béja	7 Novembre 2012
Ain Soltan-Jendouba	6 Décembre 2012
Takrouna-Kef	12 Décembre 2012
El Grafa-Jendouba	20 Décembre 2012
Ain Soltan-Jendouba	26 Septembre 2013
Errhim-Jendouba	20 Novembre 2013
Ain Soltan-Jendouba	21 Novembre 2013

- Practical guide (FAO)



- Practical guide (arabic- AVFA)



Biochemical composition

- Fatty acid composition
- Phenolic composition
- Composition of tocopherols and carotenoids
- Phytosterols

Biochemical composition

- Oil rich in unsaturated fatty acids (75%)
- Oil rich in vitamin E
- Oil rich in β carotene
- Oil rich in phenols

	Argan oil	Oilve oil	Lentisk oil
Unsaturated fatty acids	80%	80%	75%
Vitamine E	35 mg/kg	190 mg/kg	97 mg/kg
Phenols	3.220 mg/kg	792.983 mg/kg	4260.57 mg/kg

Biochemical composition

- Publications

Food Chemistry 257 (2018) 206–210

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Phenolic profile and effect of growing area on *Pistacia lentiscus* seed oil

Faten Mezni[a,*], Awatef Slama[a], Riadh Ksouri[b], Ghaith Hamdaoui[b], Mohamed Larbi Khouja[a], Abdelhamid Khaldi[a]

[a] National Institute for Researches on Rural Engineering, Water and Forests, INRGREF, BP 10, Ariana 2080, Tunisia
[b] Center of Biotechnology Borj Cedria, B.P. 901, 2050 Hammam-Lif, Tunisia

ARTICLE INFO

Keywords:
Pistacia lentiscus
Seed oil
Phenolic profile
Growing area

ABSTRACT

In this investigation, we aimed to study, for the first time, the phenolic composition of *Pistacia lentiscus* seed oils from different growing areas. Extraction of the phenolic fraction from oils was done by methanol/water. Phenolic profiles were determined using chromatographic analysis by High Performance Liquid Chromatography (HPLC-DAD/MSD) and its quantification was done using an internal standard which is unidentified in the studied oil (syringic acid). Forty phenolic compounds were quantified and only eighteen of them were identified. The eight studied oils showed different phenolic profiles. The total phenols amount varied from 538.03 mg/kg oil in Jbel Masour oils to 4260.57 mg/kg oil in oils from Kef Erraai. The highest amount of secoiridoids was reached by Bouchoucha oil containing 366.71 mg/kg oil of Oleuropein aglycon. Oils from Kef Erraai locality contained the highest concentrations in flavonols (377.44 mg/kg oil) and in phenolic acids

Biological properties

- Important antibacterial power:
  - *Escherichia coli, Salmonella typhimirium, Clostridium perfringens,……..*
- Study of anticancer power :

⟹ Inhibitory effect on BHK21 cell growth.

Biological properties

- Healing power
- Formulation of an ointment based on lentisque oil
- Greater healing power than Cicaderma®
- Patented Ointment: (Patent registered with INNORPI TN2016 / 0206)

Biological properties

- Publications

Natural Product Research, 2014

Taylor & Francis

PHARMACEUTICAL BIOLOGY
2015; EARLY ONLINE: 1–5
http://dx.doi.org/10.3109/13880209.2015.1079222

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Evaluation of *Pistacia lentiscus* seed oil and phenolic compounds for *in vitro* antiproliferative effects against BHK21 cells

Faten Mezni[1], Sarra Shili[2], Nejia Ben Ali[2], Mohamed Larbi Khouja[1], Abdelhamid Khaldi[1], and Abderrazak Maaroufi[2]

[1]National Institute for Research in Rural Engineering, Water and Forests, INRGREF, Ariana, Tunisia and [2]Laboratory of Epidemiology and Microbiology, Bacteriology and Biotechnology Development Group, Pasteur Institute of Tunisia (IPT), Tunis, Tunisia

ABSTRACT

Context: Within the global context of increasing cancer diseases, natural products are important in devising new drugs and providing unique ideas in cancer therapy. In Tunisian folk medicine, *Pistacia lentiscus* L. (Anacardiaceae) fixed oil is used for cancer treatment.

Objective: This investigation studied, for the first time, the antiproliferative effect of *Pistacia lentiscus* fixed oil and its phenolic extract on BHK21 cancer cells.

Materials and methods: Oil was extracted from fruits harvested in northwest Tunisia and the phenolic fraction was obtained by mixing with methanol. The anti-proliferative activity of the two tested substances on BHK 21 cells were investigated *in vitro* using trypan blue assays. Cells were treated with different concentrations of *P. lentiscus* oil (0.009, 0.018, 0.036, and 0.09 g/mL) and the phenolic extract (0.007, 0.014, 0.03, and 0.07 g/mL) for 24, 48, and 72 h.

Results: The inhibitory effect of *Pistacia lentiscus* fixed oil increases with the increase in dose. The IC_{50} value was estimated at 0.029 g/mL. The percentage of cell viability was 42.46 ± 3.4% at a dose of 0.09 g/mL and was significantly lower than that of the untreated control (96.24 ± 2.5%, $p<0.01$). The phenolic extract demonstrated a dose- and time-dependent inhibitory effect on BHK21 cell growth. After 48 h of incubation, the IC_{50} value was estimated at 0.15 g/mL.

ARTICLE HISTORY
Received 2 December 2014
Revised 30 May 2015
Accepted 29 July 2015
Published online 5 October 2015

KEYWORDS
Fixed oil, immortal cells, mastic tree, phenols, viability

Conclusion

- The concern for resource conservation increases systematically with any recovery made (innovation or improvement of management)
- More appropriation
- Some forest genetic resources are less endangered today
- Some examples but promising prospects

Thank you

Abdelhamid Khaldi - INRGREF