National Centre for Nuclear Sciences and Technology (CNSTN)

TUNISIA

Use of the Accelerators in the Socio-Economic Development in Tunisia

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Mokhtar KRAIEM

Irradiation Unit – CNSTN

mokhtar.kraiem@cnstn.rnrt.tn

www.cnstn.rnrt.tn

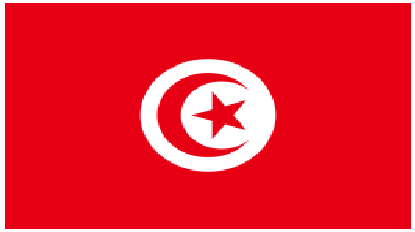
General informations about Tunisia

Geographic Situation

- Location : Northern Africa, bordering the Mediterranean Sea
- Area: 163.610 sq km
- Coastline : 1.148 km
- Natural resources: phosphates, iron, lead, zinc, salt
- Population : 10.3 millions
- Main languages: Arabic, French

General informations about Tunisia

Economy



Main sectors:

- ✓ Agriculture: olives, olive oil, grain, tomatoes, citrus fruit, sugar beets, dates, almonds, beef
- ✓ Industry: petroleum, mining (phosphate), textiles, footwear, beverages
- ✓ Tourism & Services

Status of Radiation Processing in Tunisia

Radiation processing technology started in Tunisia by the establishment of a Pilot Plant Gamma Irradiator in 1999 in National Centre for Nuclear Science and Technology (CNSTN).

In order to increase the productivity and widen the field of applications, CNSTN capabilities are presently reinforced by the establishment of a Semi-Industrial Electron Beam Accelerator. This machine has a variable beam energy ranging from 5 to 10 MeV and has a maximum power of 5 kW. It is expected to be in operation in the second half of 2009.

Status of Radiation Processing in Tunisia

These two irradiation facilities are designed to be used for the promotional activities of radiation processing applications, in particular for conservation of foodstuff and sterilisation of medical devices and will also be dedicated to play a great role in enhancing research and development work and providing services to manufacturers.

Status of radiation processing in Tunisia

National Regulations

1- Legislation for ***Agro-food products*** treatment (April 2002) allowing radio-treatment of :

- Spices & Aromatics;
- Potatoes;
- Onions & Garlic's;
- Dried Fruits and Vegetables.

2- Legislation for Radiation treatment of ***single-use medical products*** (December 2003).

Irradiation facilities

Gamma irradiator

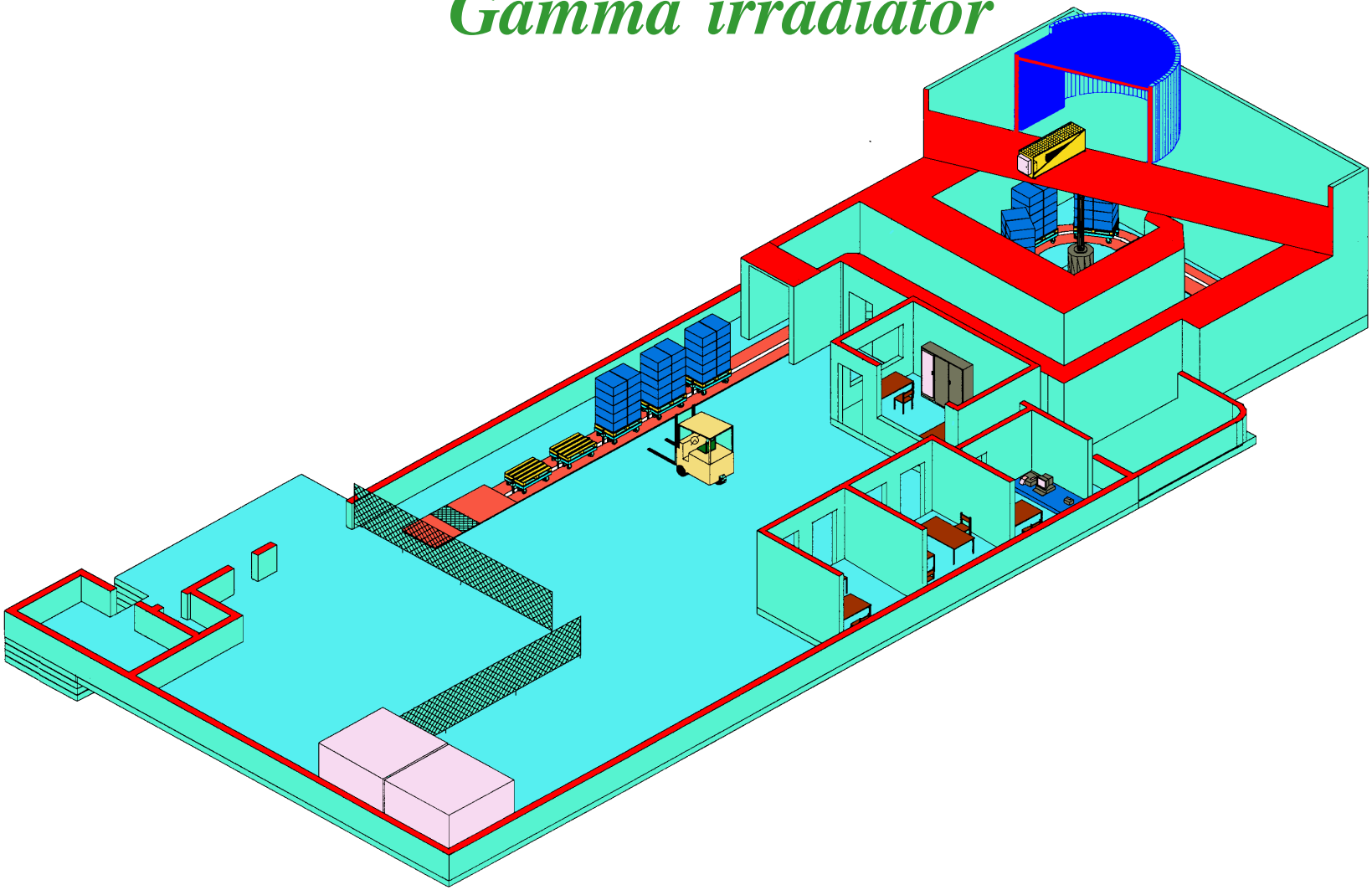
Gamma facility consists of :

- irradiation source ,
- concrete shielding including a labyrinth,
- conveyor system,
- control room,
- dosimetry laboratory,
- warehouse for irradiated and non-irradiated products,
- refrigerated rooms.

The products are transported inside the irradiation cell using 5 carriers moved by electromechanical conveyor system fixed on the ground.

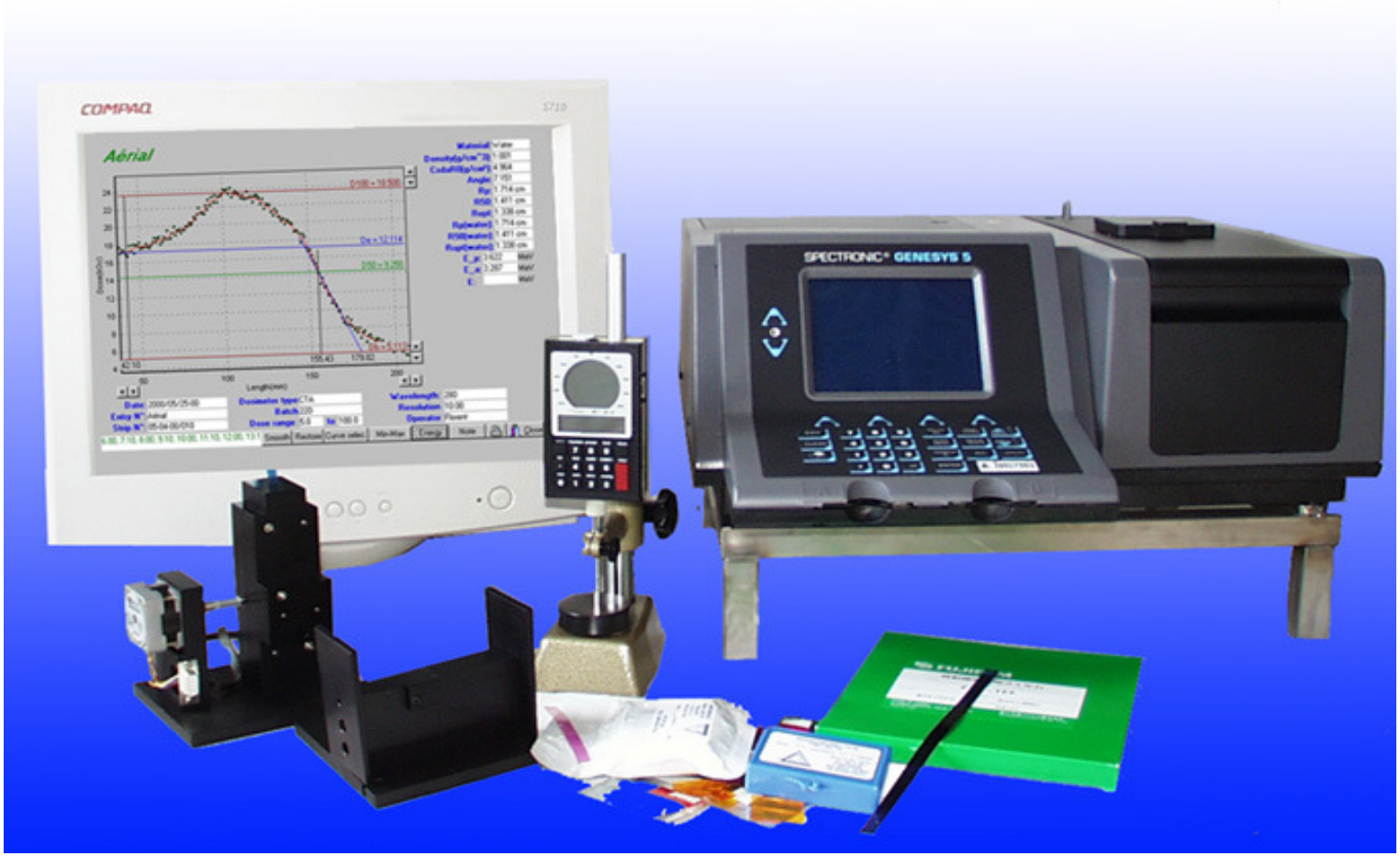
Irradiation facilities

Gamma irradiator



Infrastructure

Dosimetry laboratory



Infrastructure

Microbiology laboratory

Irradiation facilities

EB accelerator

Semi-industrial EB Accelerator will be set in the proximity of gamma facility.

It will be used:

- for the development and tests studies
- as unit of accompaniment in the development of industrial treatments on standby of the future investments by the industrial companies

It should answer the needs expressed by the manufacturers and researchers for the development for new and concrete applications.

Assistance from IAEA : TUN/8/016 and RAF/8/044.

Irradiation facilities

EB accelerator

Type : LINAC

Energy : 5 ; 7.5 & 10 MeV

Power : 5 kW

Scanning Width (industrial mode): 30-60 cm

Throughput:

~ **3.2 m^3/h** for medical products @ **25 kGy**

~ **1 ton/h** for spices @ **10 kGy**

Irradiation facilities

EB accelerator

Main Components:

- Accelerating section
- Conveyor with rollers to convey products to be processed under the beam. Under-beam conveyor speed : 0,15 to 5 m/min.

  Under-beam conveyor can be removed for non-industrial mode
- Data processing equipment dedicated to order and control the accelerator
- Electric and safety systems
- Cooling system (regulated) for the control of the temperature of accelerating section
- Dosimetry system

Irradiation facilities

EB accelerator

Irradiation facilities

EB accelerator

Planning of Realization:

- Building construction: 2006-2007
- Assembly and tests on factory: 2005
- Assembly and tests on CNSTN's site: from 11/2008 to 07/2009
- Exploitation date (planned): July 2009

Radiation Processing Activities

- Services
- R & D studies

Status of radiation processing in Tunisia

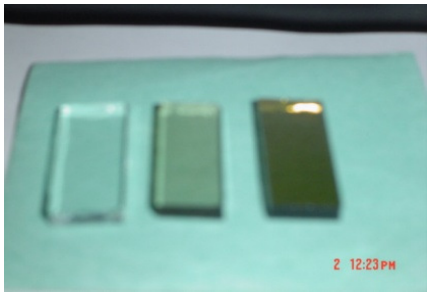
Providing Services

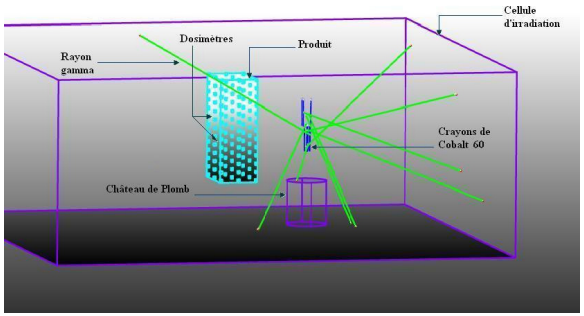
- Decontamination & preservation of foodstuffs (spices)
- Sterilization of healthcare products (suture thread, petri dishes,…)
- Conservation of art objects : restoration of cultural heritage

Status of radiation processing in Tunisia

R & D studies

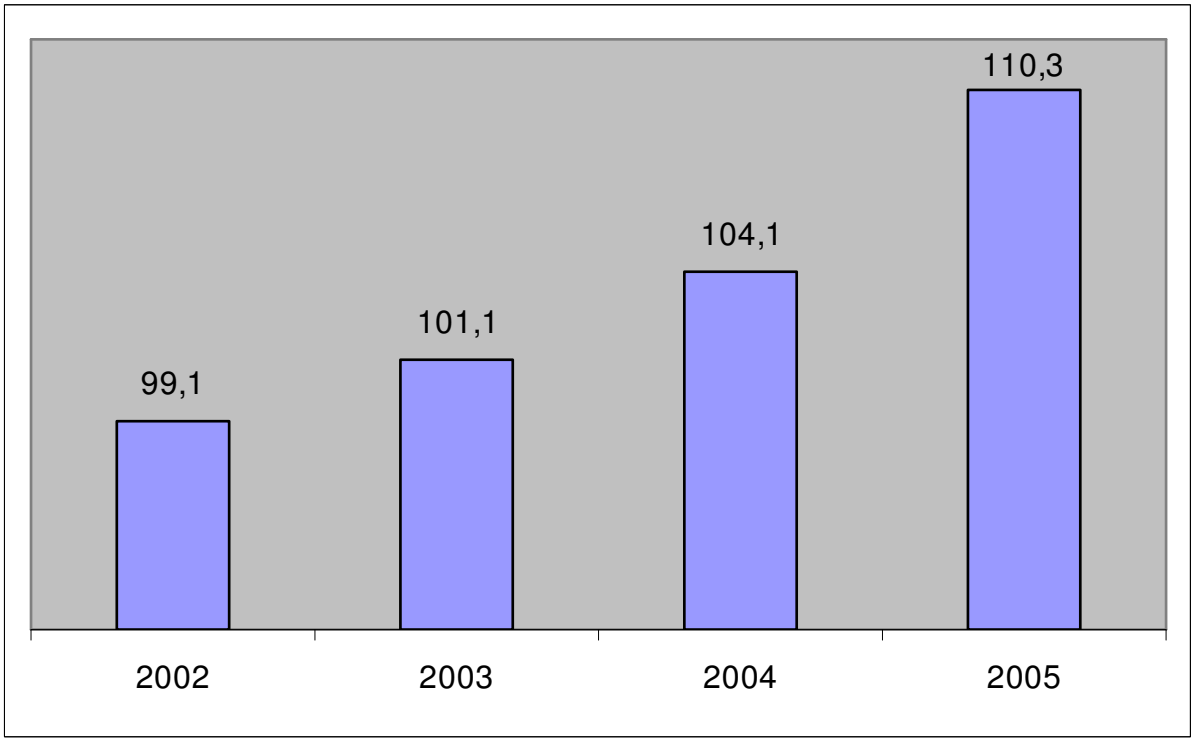
- Agro foods : spices, strawberries, cooled chicken meats, shrimps, cooked dishes,…
- Materials : Glass, polymers
- Textile coloration (naturals & artificial)
- Monte Carlo Simulation (GEANT 4)





Status of radiation processing in Tunisia

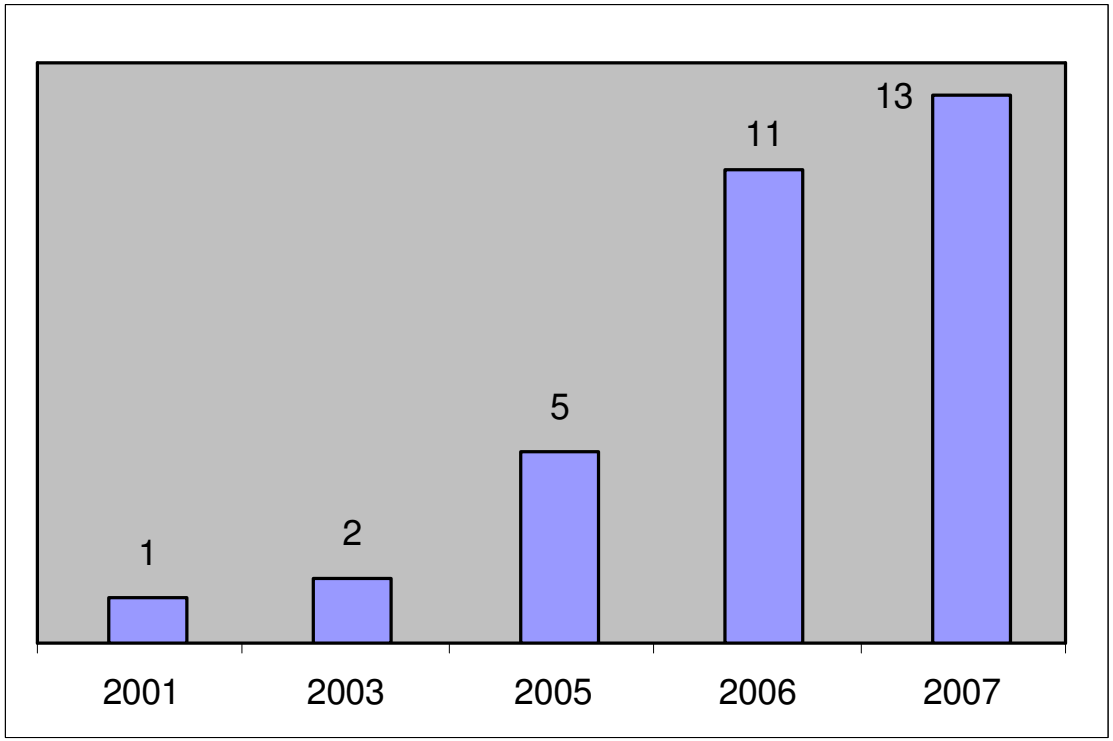
Radiation Sterilization of Health Care Products



Production of pharmaceutical products (index 100 in 2000)

Status of radiation processing in Tunisia

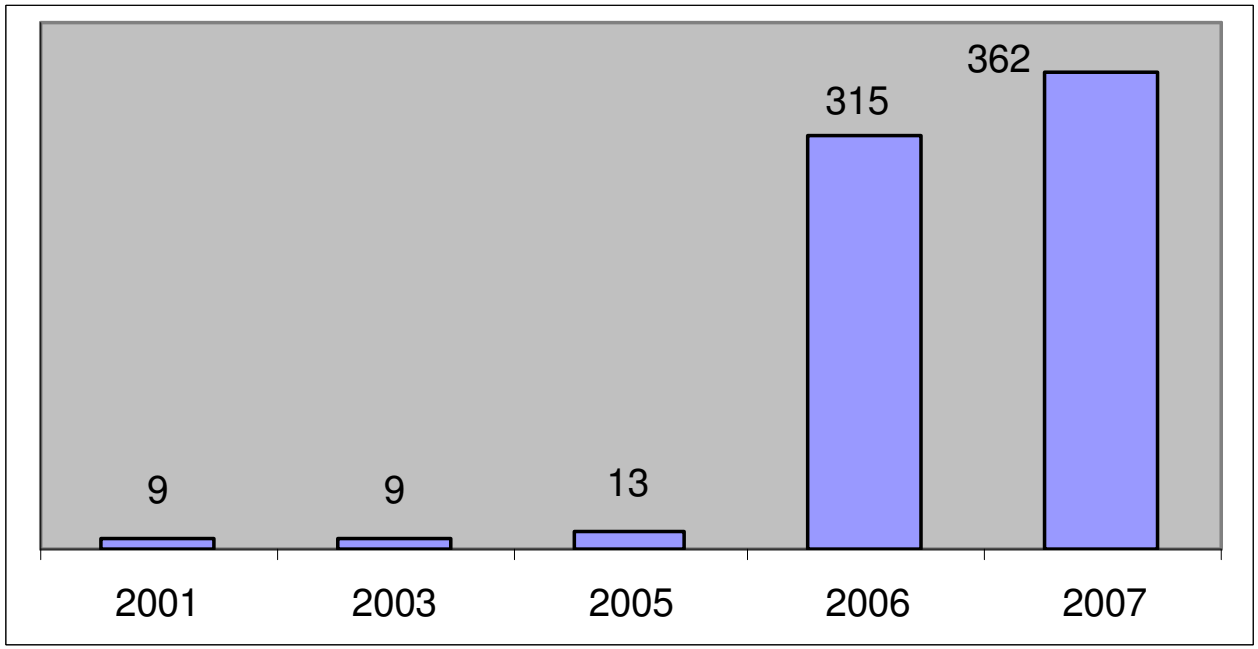
Radiation Sterilization of Health Care Products



Export of pharmaceutical products (Million Dinars)

Status of radiation processing in Tunisia

Radiation Sterilization of Health Care Products



Export of medical and surgical products (Million Dinars)

Status of radiation processing in Tunisia

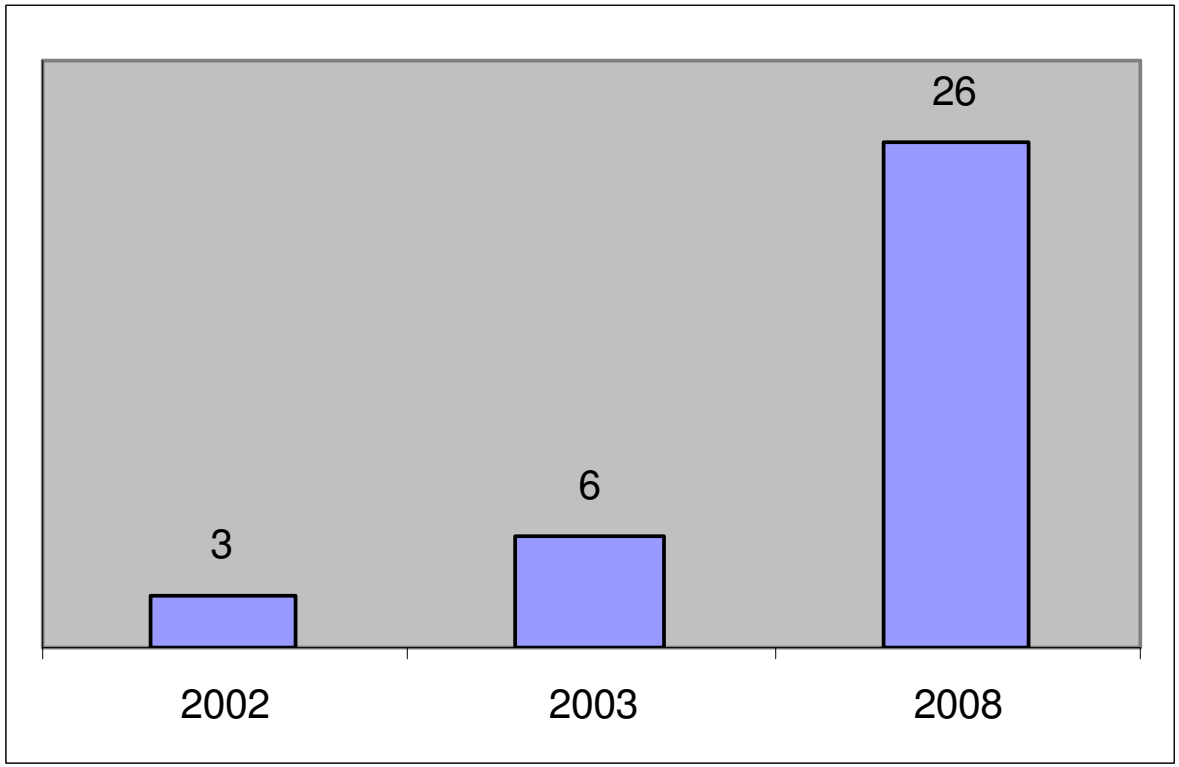
Radiation Sterilization of Health Care Products

Product	Number of industrials
Administration set	4
Dressing	4
Single use pharmaceutical products	14
Veterinarian use pharmaceutical products	3
Syringes	2

PHARMACEUTICAL MANUFACTURERS IN TUNISIA

Status of radiation processing in Tunisia

Radiation Sterilization of Health Care Products



Export of dressings and bandages (1000 Dinars)

Status of radiation processing in Tunisia

Radiation Sterilization of Health Care Products

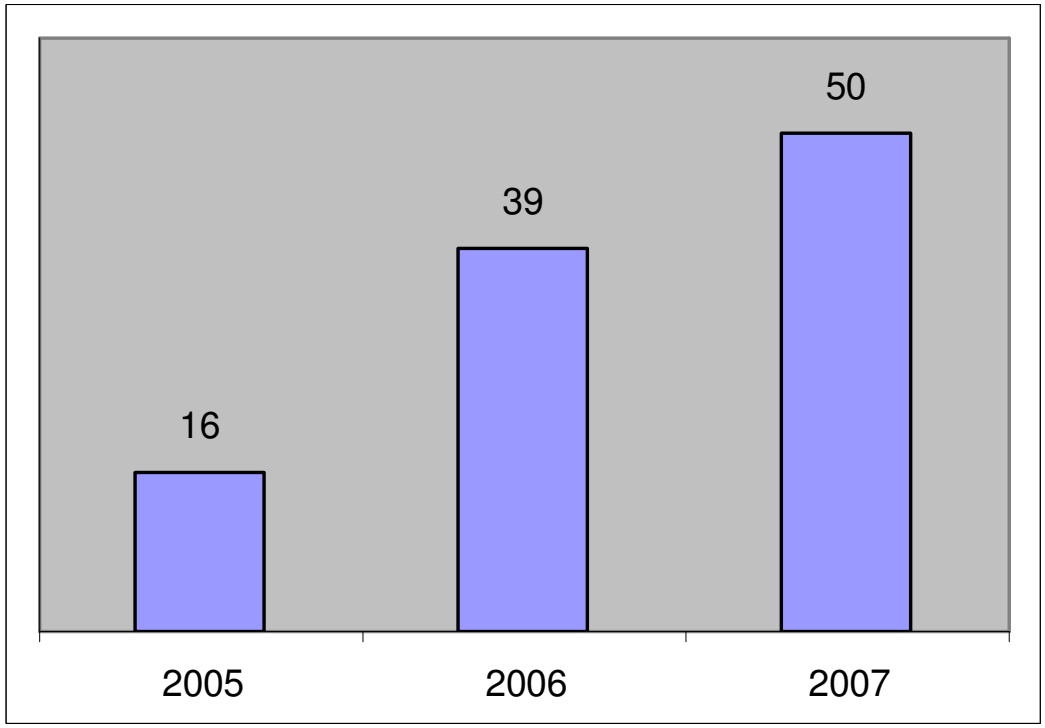
Health care products processed in CNSTN:

- Suture thread
- Tulle gras
- Dressings
- Adhesive bandage
- Petri dishes
- Nasal solution
- Solution for cleaning contact lens

Status of radiation processing in Tunisia

Cosmetics

Number of Tunisian cosmetic manufacturers is 37 in 2008.

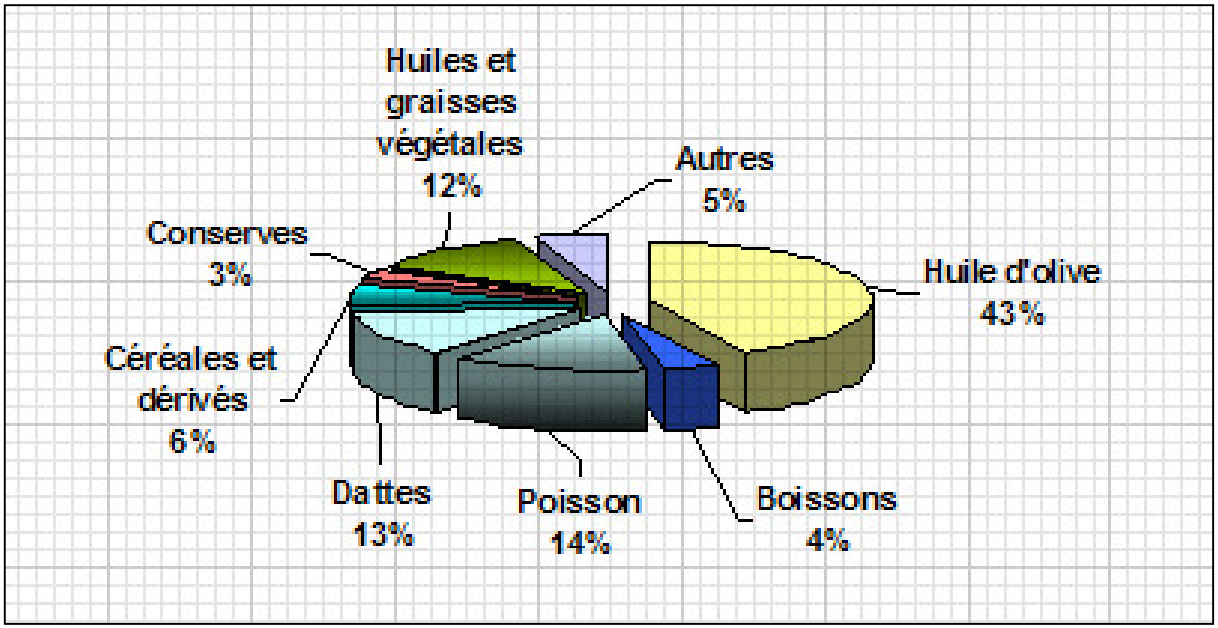


Export of cosmetics (Million Dinars)

Status of radiation processing in Tunisia

Food Irradiation

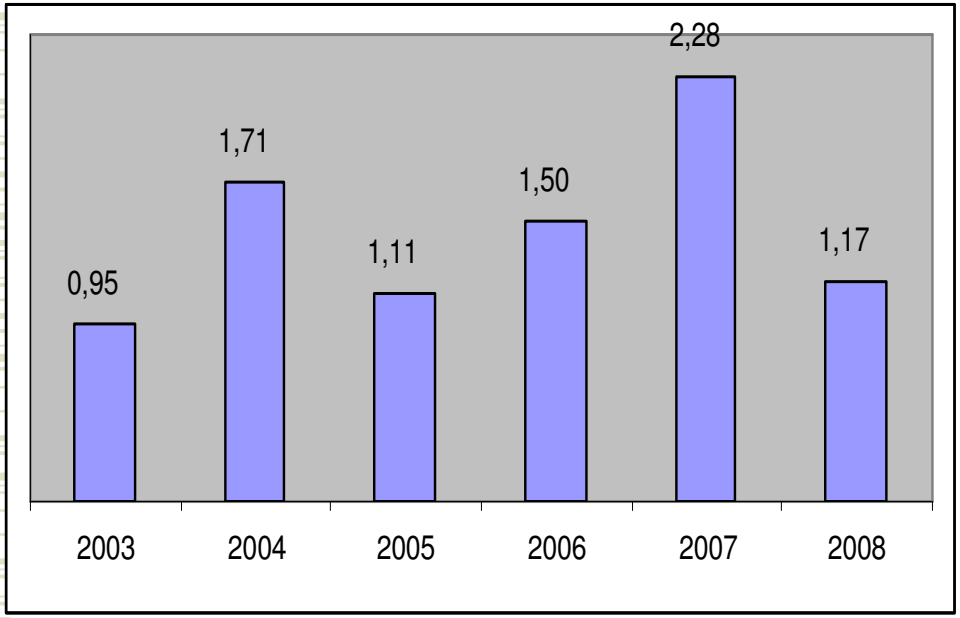
Ionizing radiation represents an efficient method for food preservation and extension of shelf life especially for national products dedicated to export.



Distribution of principal exported food products in 2007

Status of radiation processing in Tunisia

Food Irradiation

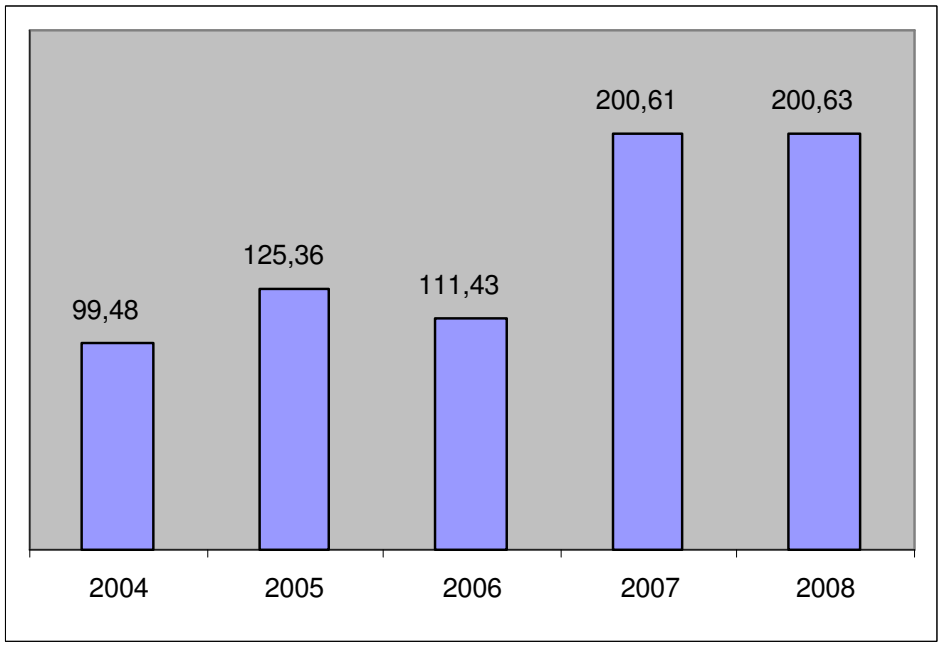


Export of Royal sea-breams (Million Dinars)

Status of radiation processing in Tunisia

Food Irradiation

Tunisian dates occupies 30% of the world exchange value and satisfies more than 40% of the needs of the European Community.

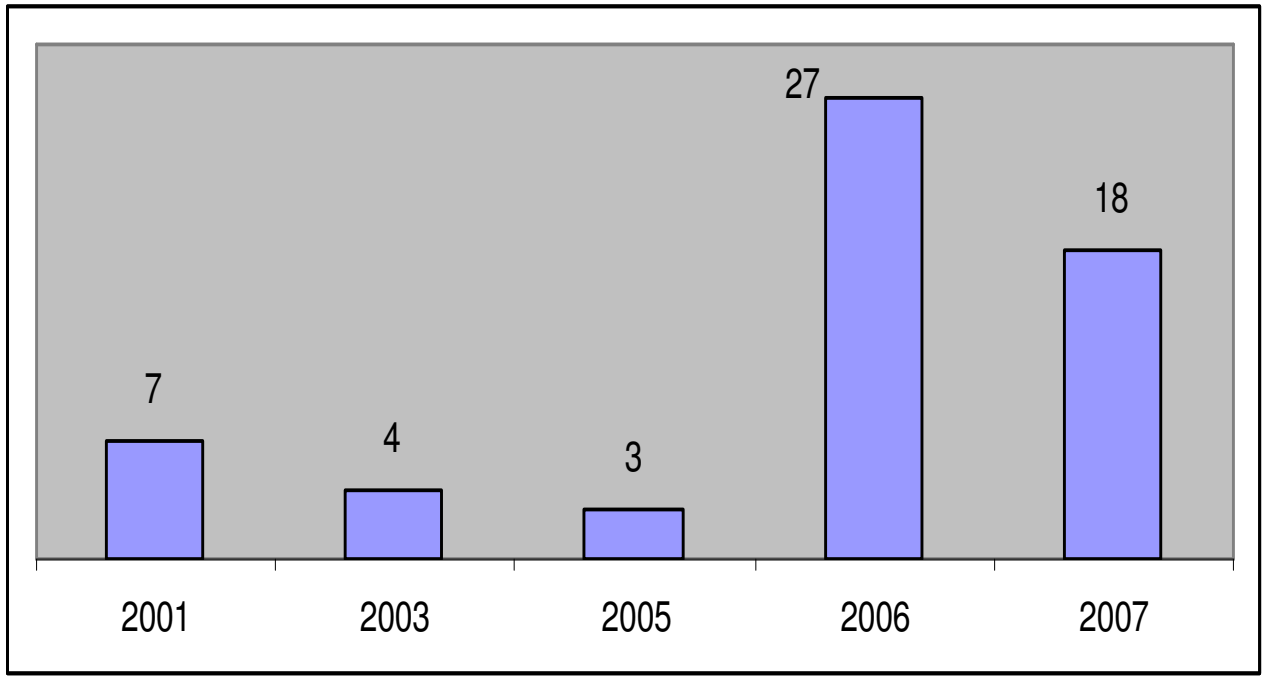


Export of dates «Deglet Nour» (fresh state or dry) (Million Dinars)

Status of radiation processing in Tunisia

Crosslinking of Thermoplastics

Technico-economic feasibility study showed that many Tunisian companies are strongly interested by radiation reticulation.

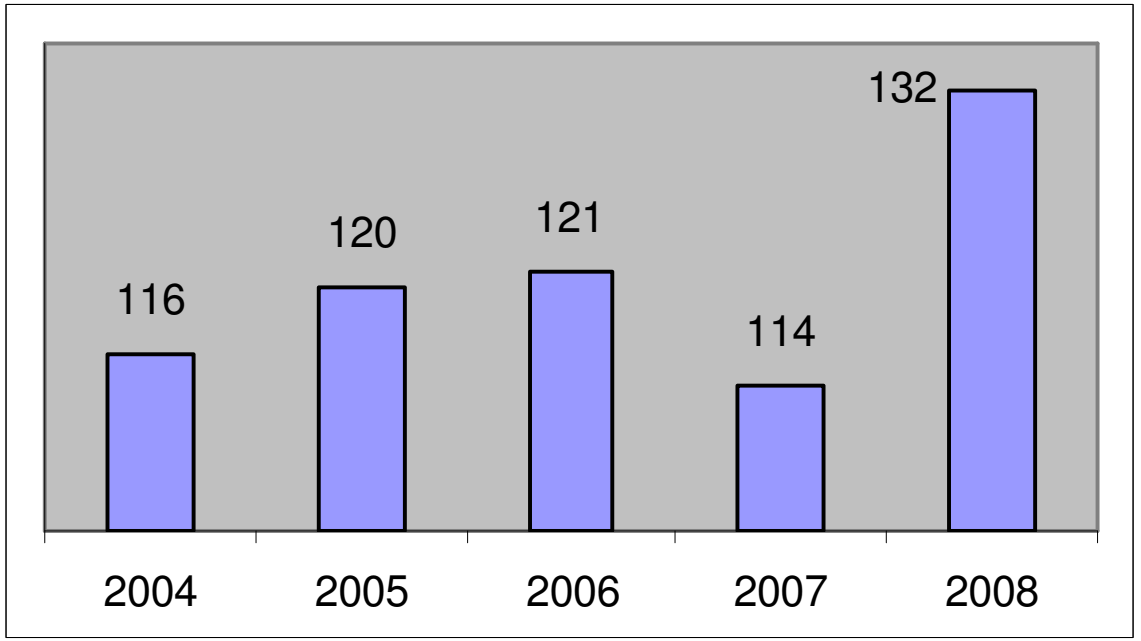


Export of electric cable (Million Dinars)

Status of radiation processing in Tunisia

Coloration of Glass Articles

- In Tunisia, the production of glass currently totals almost 140 Million dinars in 2007
- In June 2008, we estimate at 34 the number of industrial glass companies in Tunisia

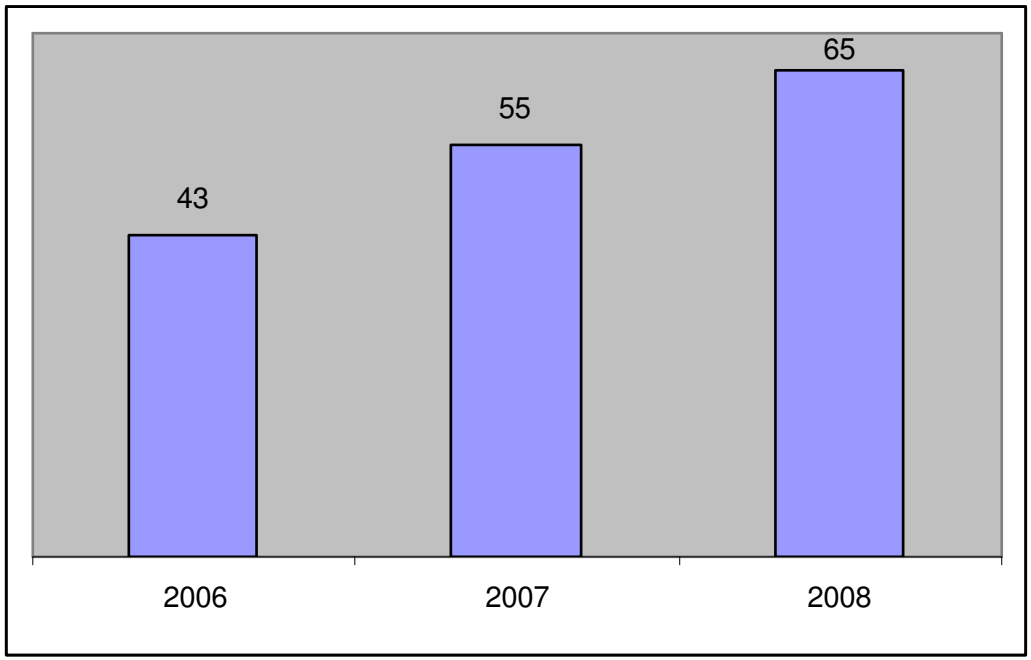


Evolution of export of glass industry (index 100 in 2000)

Status of radiation processing in Tunisia

Art Objects

Agreements with National Museums in order to benefit from radiation technology for the conservation and the restoration of our cultural heritage.



Volume of radiation processing of art objects in CNSTN between 2006 and 2008 (m^3)

Status of radiation processing in Tunisia

Environment

Ionizing radiation technology offers an alternative method since existing purification systems are close to their limit ability (toxicity) in treatment of incoming wastewater.

Waste production (1 000 tons)			Waste Disposal (number of controlled landfills for non-hazardous waste)
Hazardous Waste	Industrial Waste	Municipal Waste	
144 (2002)	320 (2002)	2025 (2004)	5 (2006)

TUNISIAN WASTE PRODUCTION AND WASTE DISPOSAL

Summary

❖ Radiation Processing using e-beam accelerator constitutes a promising technology for several industrial treatments services.

❖ For the next years, it is expected that industrial radiation applications in Tunisia will have more development along with the economic development.

❖ The main objective of CNSTN is to promote radiation technology in Tunisia among the end-users and to prove the technico-economic advantages in order to install their own industrial scale facilities.

THANK YOU !