

Alimentos y envases a la luz del sincrotrón



ALBA Industrial Office

A large facility to study the inner structure of materials



1st
SCIENCE FACILITY
IN SOUTH-WEST EUROPE

210
STAFF (20% INTERNATIONAL)

1800
RESEARCHERS PER YEAR
(35% INTERNATIONAL)

500
EXPERIMENTS PER YEAR

210 M€
PUBLIC INVESTMENT
(2011)

~5000
HOURS PER LAB PER YEAR

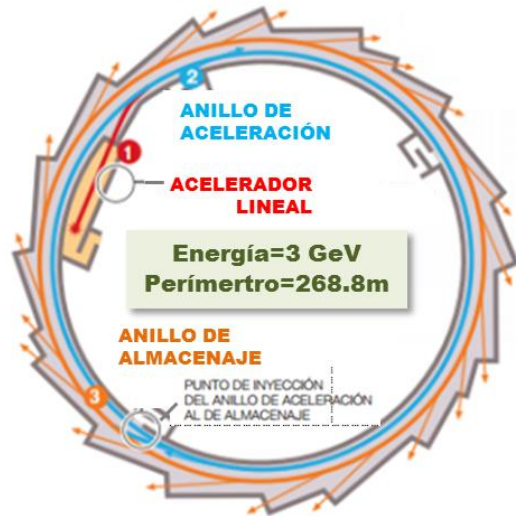
TOP-NOTCH RESEARCH IN:

- BIOTECHNOLOGY AND LIFE SCIENCES
- MICROELECTRONICS AND NANOTECHNOLOGY
- ENVIRONMENT, ENERGY AND AEROSPACE
- MATERIALS DESIGN, DRUGS AND FOOD
- CULTURAL HERITAGE

What is a synchrotron?

A synchrotron is a source of extremely powerful X-rays (synchrotron light) produced by using electrons moving at the 99.9999% of speed of light in a ring with a very high vacuum.

COMPLEJO DE ACELERADORES



- 1 Acelerador lineal**
Se generan electrones en un tubo de rayos catódicos y se envían por un acelerador lineal
- 2 Anillo de aceleración**
Electroimanes aceleran los electrones hasta que alcanzan una velocidad similar a la de la luz
- 3 Anillo de almacenaje**
Los electrones giran en órbita por el tubo del anillo de almacenaje y van perdiendo energía en forma de rayos X

Synchrotron light is used to understand the **structure** and **properties** of materials (morphology, chemical, electronic and magnetic structure) and to analyze physical, chemical, geological and biological **processes** in a nondestructive way.

WHY DO COMPANIES USE ALBA SYNCHROTRON ?

The ALBA Synchrotron techniques allow to obtain outstanding results not achievable with other equipments or techniques very valuable to help boosting the competitiveness of companies.

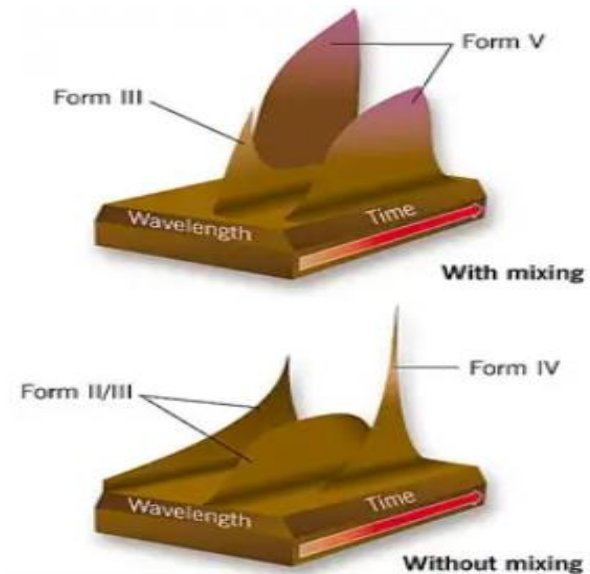
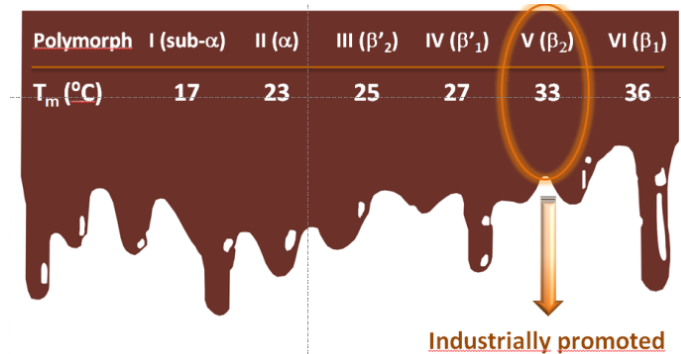
-  LOWER DETECTION LEVELS
-  CHEMICAL MAPPING
-  OXIDATION STATE DETERMINATION
-  HIGHER RESOLUTION
-  FASTER EXPERIMENTS
-  WIDE VARIETY OF SAMPLES MEASURABLE

Chocolate with velvet texture

Cadbury, one of the first very important industrial applications, 1998 (SRS-Daresbury, UK)



- The taste of chocolate depends on which crystalline forms predominate as the chocolate cools in the factory.
- Chocolate can crystallize into six different polymorphs: Form V produces good taste (smooth texture). Form III produces poor taste (brittle)!
- X-rays irradiated the cocoa butter and very fast measurements of the diffraction patterns at different temperature and mixing conditions were done.
- Without mixing, form V does not appear, and less palatable crystalline forms predominate
- The unpalatable II and III forms appear between temperatures of 22.3 °C and 23.55 °C but form V appears at Temp. higher of 23.86 °C.
- The data showed the optimum conditions for good tasting chocolate manufacture.
- Cadbury lowered tempering temperatures significantly, bringing energy and cost savings, and optimized a complex process, with subsequent benefits to profits.



Source: www.newscientist.com/article/mg15821331-100-cool-chocolate/

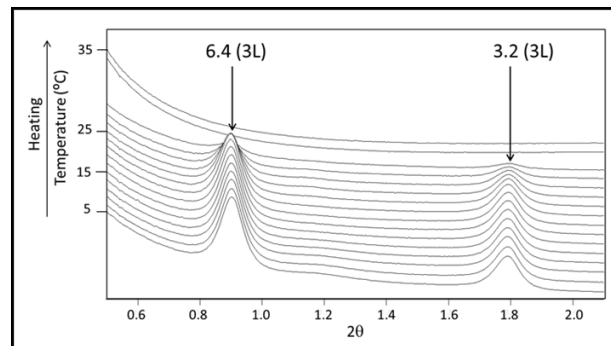
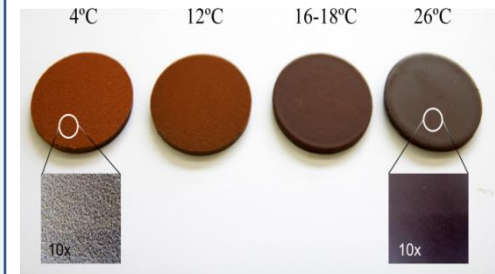
Making better chocolate

Crystallization of the velvet effect (Enric Rovira chocolates)



- Formation of thin layers of Cocoa Butter crystals with lower melting point than normal chocolate that creates soft mouthfeel.
- Use of two different substrates: metal and chocolate
- Different temperatures of crystallization: 4°C, 12°C, 16°C, 18°C
- Influence of the surface temperature (supercooling)
- Low temperature and low cooling rate enhance the velvet effect.**

Source: Bayés-García, L. et al. *Cryst. Growth Des.* 2015, 15, 4045.

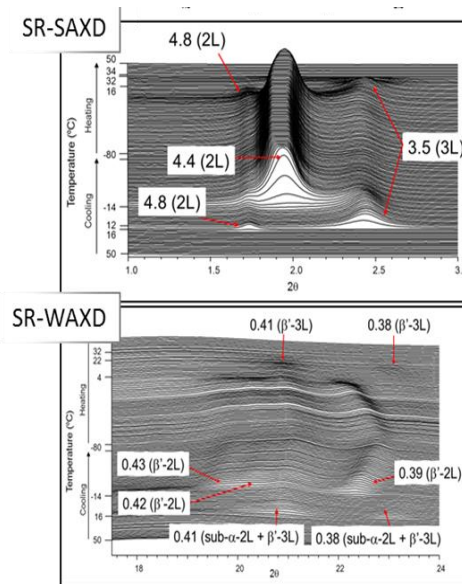


SR-XRD confirmed the only presence of **Form V** of cocoa butter

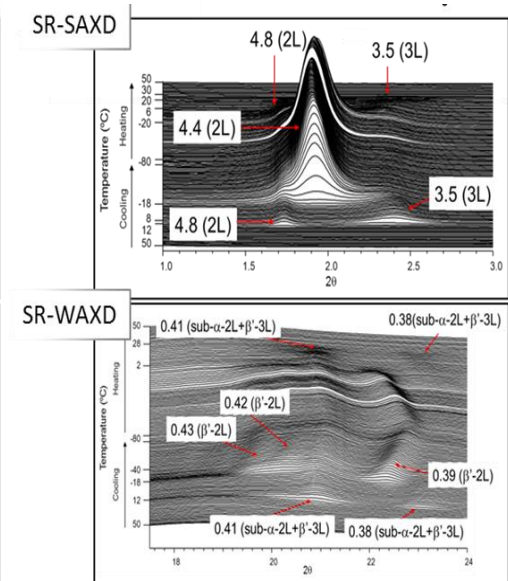


- Food adulteration is commonly applied to high-commercial-value products and/or produced in high tonnage.
- Iberian ham: Most appreciated cured ham. Particular and intense sensorial properties.
- Different product categories depending on the system of animal nutrition in the fattening phase: cebo, bellota...
- Differentiation of Iberian ham fat from pigs produced with different systems of animal nutrition: cebo and bellota.
- This technique can distinguish both hams: cebo and bellota and be useful for fraud identification.

CEBO



BELLOTA

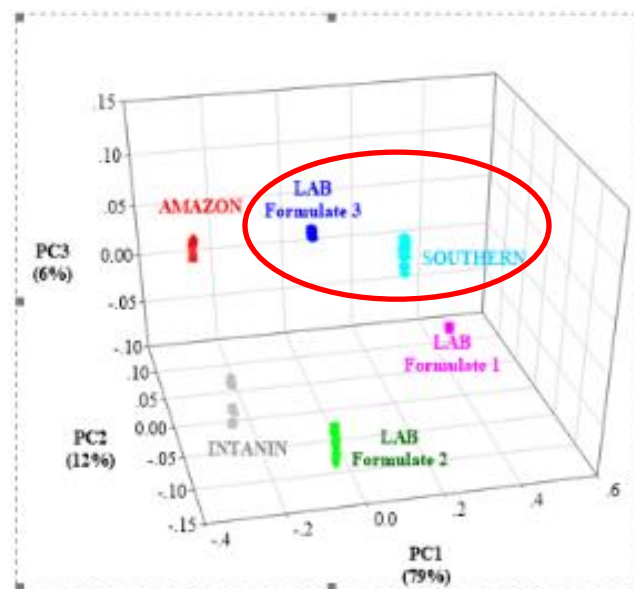


Source: Bayés-García et al. Food Control 2016, 60, 370.

Coffee analysis

Similarities between fresh coffee and ready-to-drink coffee

- Southern Coffee Co. wanted to produce fresh ready-to-drink coffee in sealed packaging with a quality closest to fresh coffee and a shelf life of over 3 months at room temperature.
- Suranaree University and Thailand Synchrotron co-studied and developed fresh coffee in 150 ml glass to keep the freshness and fragrance of coffee.
- FTIR spectroscopy was used to examine the components of ready-to-drink coffee samples and compare them with fresh coffee.
- It was found that coffee from the modified formulation (Lab Formulate 3) was similar to Southern coffee than the other formulas.
- **The technique could be used as "Biomarker" to classify the differences and similarities between fresh coffee and ready-to-drink coffee.**



<https://www.slri.or.th/en/list-research/472-formula-development-of-fresh-ready-to-drink-coffee-with-synchrotron.html>

Poly(lactic acid) mixed with montmorillonite as bionanocomposites



- PLA is a thermoplastic polyester derived from 100% renewable sources such as sugar, corn, potatoes, etc. (bioplastic)
- PLA is brittle and mechanically weak. PLA was blended with natural rubber and nanoclay (montmorillonite) to provide the desired mechanical properties.
- Deformation mechanisms were investigated in situ by (SAXS/WAXS).
- PLA has a failure mechanism through crazes. PLA/NR is ductile, forms voids when stretched. PLA/NR/bionanocomposites allows larger elongation through crazes that allows polymer chain orientation.
- The technique allowed to detect the areas where the tensions were located and to explain why some materials are more brittle than others.

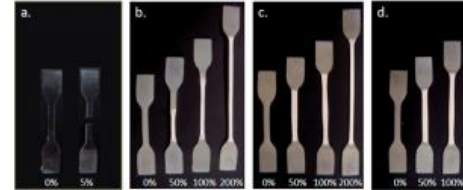
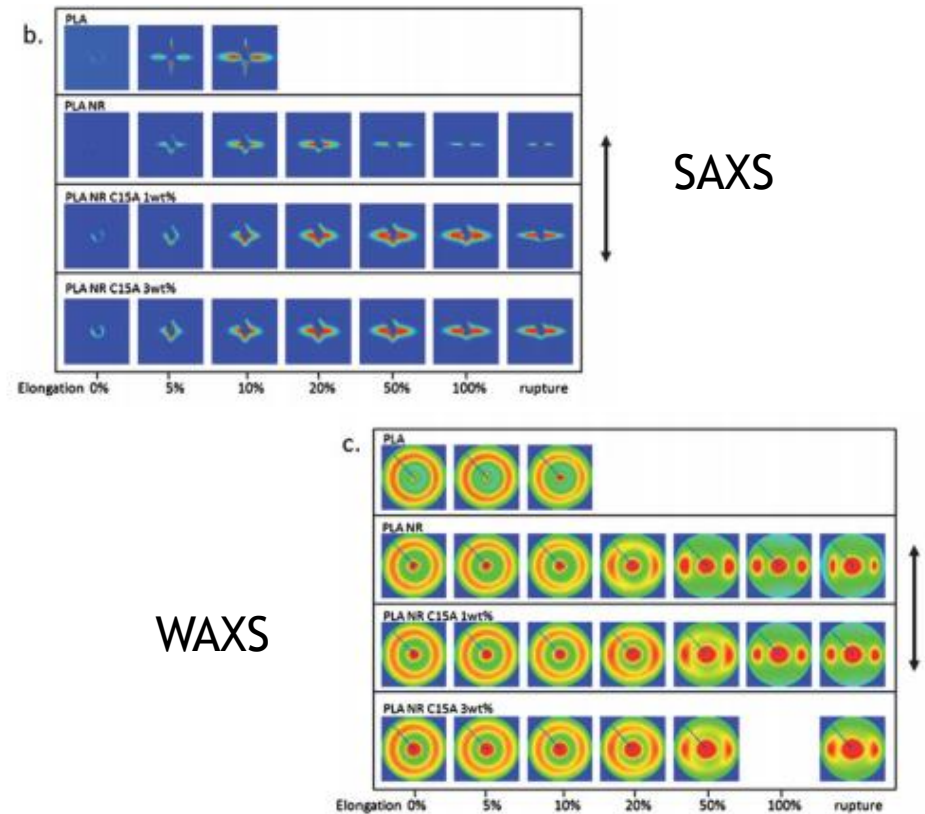


Fig. 4 Samples stretched at different elongations (a) PLA, (b) PLA/NR, (c) PLA/NR/C15A 1 wt%, (d) PLA/NR/C15A 3 wt%.



Source: N. Bitinis et al. *Soft Matter* 2012, 8, 8990-8997.



HOW TO CONTACT ALBA



The ALBA Synchrotron has established an Office of Industry Relations as a single contact point to provide complete service to its customers, maintaining confidentiality and providing support throughout the service.

industrialoffice@cells.es

Thank you for your attention !

