

Processing cottonseed into biodegradable materials for agriculture as an alternative to synthetic polymers in Latin America

COTONBIOMAT

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Project Coordinator

INCO PROJECT

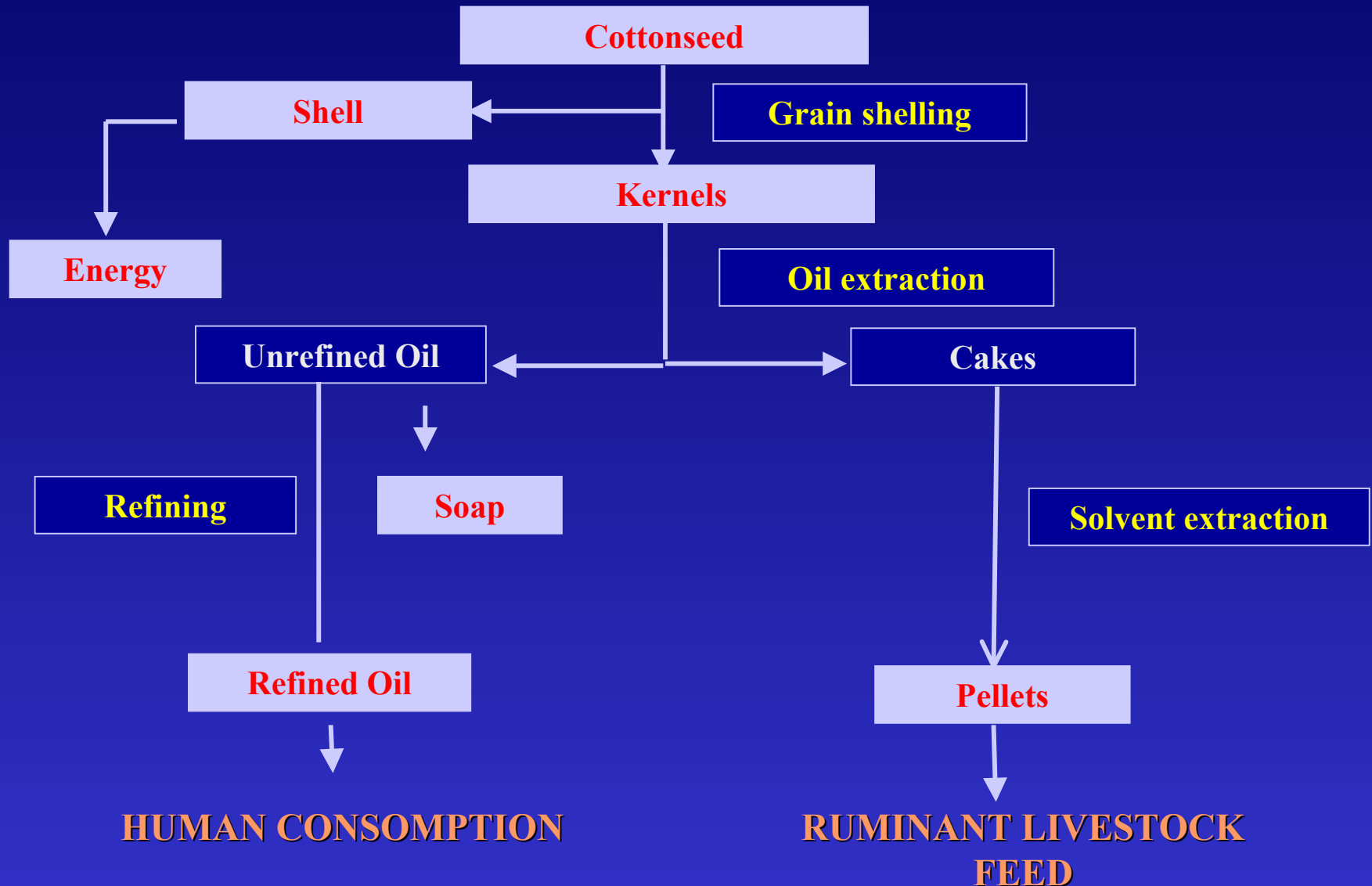
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Protein plant production in the world

Type	2000/ 2001	2003/ 2004
Soybean	175.2 (56%)	199.7 (58%)
Colza	37.6 (12%)	38.0 (11%)
COTTON	33.5 (11%)	35.0 (10%)
Groundnut	31.4 (10%)	33.8 (9.8%)
Sunflower	23.2 (7.4%)	26.0 (7.5%)
Palm (A)	7.0	8.1
Copra	5.8	5.4
TOTAL	313.7	346.0

Source USDA

Cottonseed processing



World fiber production : about 20 MT



85 % of the seed cotton commercial value

World seed production : about 35 MT



15 % of the seed cotton value

Cottonseed, an important source of plant proteins

	Kernel w/w	Cakes w/w
Proteins	30 - 40	35 - 45
Lipids	30 - 40	2 - 15
Free Gossypol	0.1 – 1.5	0.01 – 0.1
Total Gossypol	0.5 – 2.0	0.5 – 2.0
Cellulose	3 - 5	10 - 20
Soluble carbohydrates	5 - 10	5 - 10
Other : minerals, pigments, phytates, 5.4		

CIRAD cotton technology research



Search of new application in food industry ?

Problem due to gossypol



Explore new potentialities in non-food industry ?

- Cosmetic, pharmaceutical application ?

- **Biodegradable materials**



COTONBIOMAT Project

The long term objective is :

To develop industrial processes for manufacturing new biodegradable materials for agriculture in Latin America



To give extra-value generally to cotton crops and specifically to cottonseed derivatives

The utilization of locally produced biodegradable materials made with cottonseed derivatives will improve renewable natural systems in rural areas and environment management.

Technical objectives are :

- Industrial pilot scale processing technologies to make biodegradable films for :
 - mulching
 - seed coating including usefull chemicals
 - packaging
- Quantification of the economic and technical advantages and drawbacks of cottonseed-based materials for farmers and manufacturers


The state of knowledge at the beginning of the project

Many studies have explored the film-forming properties of proteins (corn zein, wheat gluten, myofibrillar proteins, soybean proteins

 Cottonseed proteins have good film-forming properties

 Protein crosslinking increases puncture strength and decrease water solubility

 **Biodegradable films from cottonseed kernels by a casting process at laboratory scale**

 Cottonseed proteins isolates are thermoplastic but it is necessary to have a better understanding of :



Protein structure and protein processibility

Interactions between proteins and non-protein components

Scientific objectives are :

To gain a better understanding of :

- rheological properties and thermomechanical behaviour of cottonseed derivatives**
- relations between structure, chemical modifications and film-forming properties**
- interactions between proteins and other non-protein molecules**
- film-forming and adhesive cottonseed protein properties**
- diffusion of active substances introduced in seed coating films**

Novating features of the project related to the state of knowledge

■ The project explored for the first time cottonseed processing by low moisture technologies

■ The project studied the wet cottonseed processibility at the industrial pilot scale and explored several industrial applications

- Calendaring

- Laminating

- Seed coating

- Composites

- Films for mulching

- Packaging

- Seed coated

Innovative approach to test the economic and feasibility of cottonseed processing into biodegradable materials

Challenge and risk associated with the project

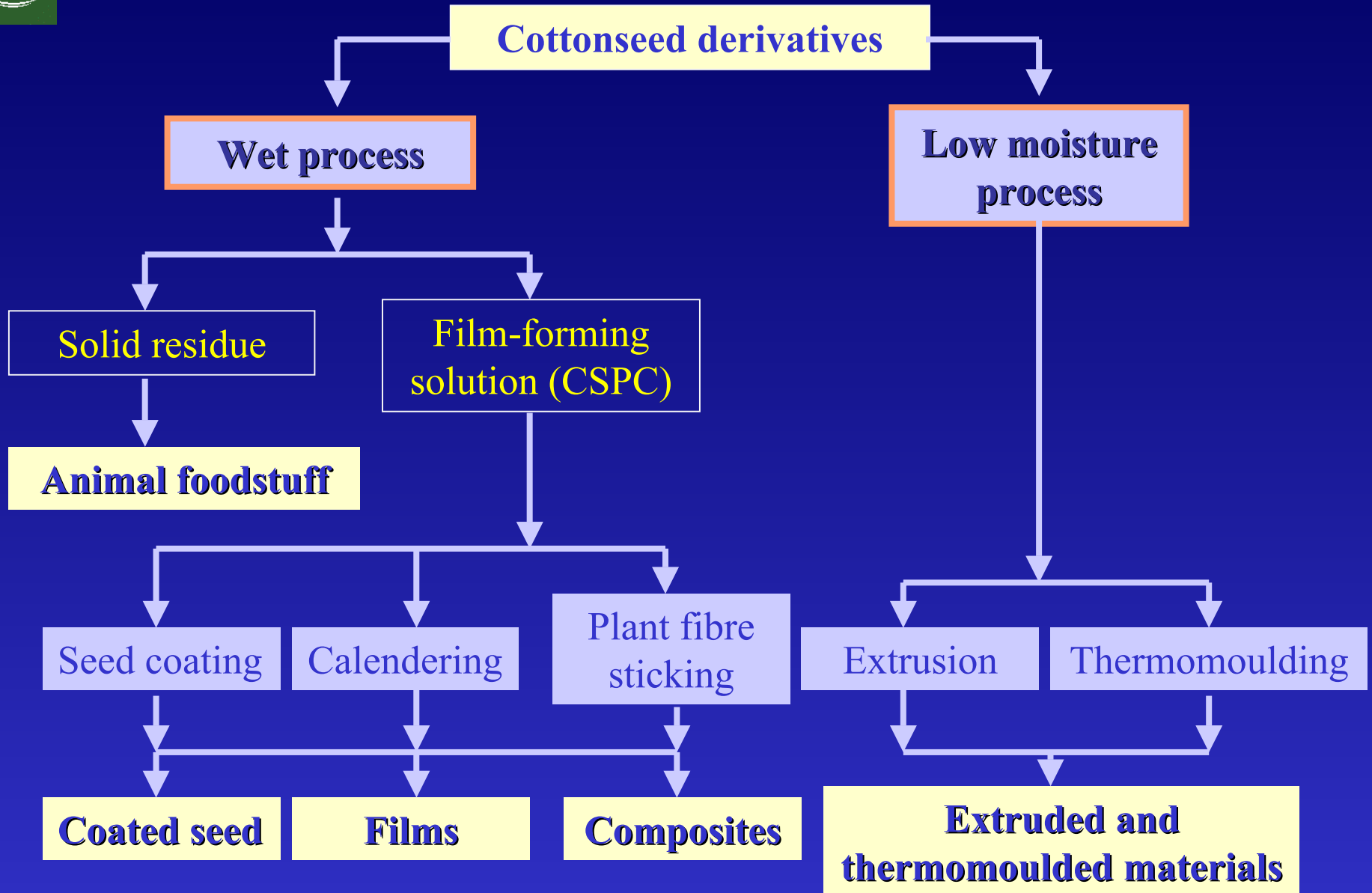
- **To produce materials, directly from raw cottonseed derivatives by usual industrial technologies (extrusion, calendering, ...)**
- **To produce competitive biodegradable materials**

A diagram illustrating the risks of the project. It features a white starburst shape with the word "Risks" inside, and a thick orange arrow pointing to the right, towards a light blue box containing a list of risks.

Risks

- Complexity of raw material composition**
- Microbiological stability, physical state and variability of the cottonseed components**
- Compatibility with the industrial machine capacity**
- Reactivity of proteins**
- Biodegradability / durability of films**

Overview of the project



Technical and economical feasibility at pilot industrial scale

Description of the consortium

USP/FUSP – Brazil

Head of WP2

Calendared materials

INCOTEC – Netherland

Head of WP3

Seed Coating

CIRAD – France

Research with all WP

Coordination and management of the project

CITIP/INTI

Head of WP 4

Composite materials

EMA/ARMINES

Head of WP5

Thermomoulded and extruded materials

Project teams

CIRAD – France

Centre de coopération international en recherche agronomique pour le développement

Dr. Catherine Marquié: project scientific coordinator, head of WP1

Dr. Jérôme Lecomte: chemical and biochemical research

Dr. Michel Fok: economist, analysis of commodity chains

Pascale Guiffrey: technician in chemistry

Gilles Morel: technician in chemistry

Hélène Guillemain: administrative officer

Hervé Gace : administrative officer

Philippe Ourcival : administrative officer

Project teams

FUSP/USP - Brazil

Foundation for Support to the University of São Paulo

**Prof. Paulo Sobral: Head of the Food Engineering Department
(FZEA, USP), head of WP2**

**Prof. Douglas Emygdio de Faria: Nutrition, University of Zootechnie of
São Paulo.**

Rosemary Aparecida Carvalho, Chemical Engineer, (FZEA, USP),

Ana Mônica Quinta Barbosa Habitante: Pharmaceutic, (FZEA, USP),

Fernanda Maria Vanin: Student of FZEA, USP

Gustavo Podadera Costa, Student of FZEA, USP,

Gisele Lourenço da Aparecida: Student of FZEA, USP,

Guilherme de Castro Moretto: Student of FZEA, USP,

Project teams

INCOTEC - Netherlands

Integrated coating and seed technology

Bob Legro: Manager of the Coating Technology Research, head of WP3

Paul Klemann: coating technology

Frans Tetteroo: encapsulation technology and additives

Project teams

CITIP/INTI - Argentina

**Centro de investigacion y desarrollo tecnologico para la industria plastica
del instituto national de tecnologia industrial**

**Dr. Patricia Eisenberg: material technology dept., National Institute of
Industrial Technology (INTI) , head of WP4**

Mariana Mollo: material technology dept., (INTI)

Marianela Speraggi: material technology dept., (INTI)

Matias Segal: cereal center dept., (INTI)

Guido De Tito: material technology dept., (INTI)

Pablo Rocci: material technology dept., (INTI)

Project teams

EMA/ARMINES - France

Ecole Nationale des Mines d'Alès, Association pour la recherche et le développement des méthodes et processus industriels

Dr. Laurent Ferry: Polymer Science, head of WP5

Joël Grevellec, doctorate student

Marc Longerey: technician

Sylvain Buonomo, Technician in plastic processing, EMA

Xavier Boetha, Student at Ecole des Mines d'Albi-Carmaux

Lauriane Giroud, Sabrina Ioudarene, Céline Vermandel, Students at Ecole des Mines d'Alès



Project management

A scientific and technological committee

A financial and administrative permanent committee

A consultative committee

Tasks and relation between participants

WP2 - Calendared materials

Optimization of COTPROT formulation
Food stuff formulation with COTPROT by-products
Calendaring of COTPROT
Economic study

WP3 - Seed Coating

Phytotoxicity of COTPROT
Optimization of COTPROT formulations for various species seed coating
Economic study

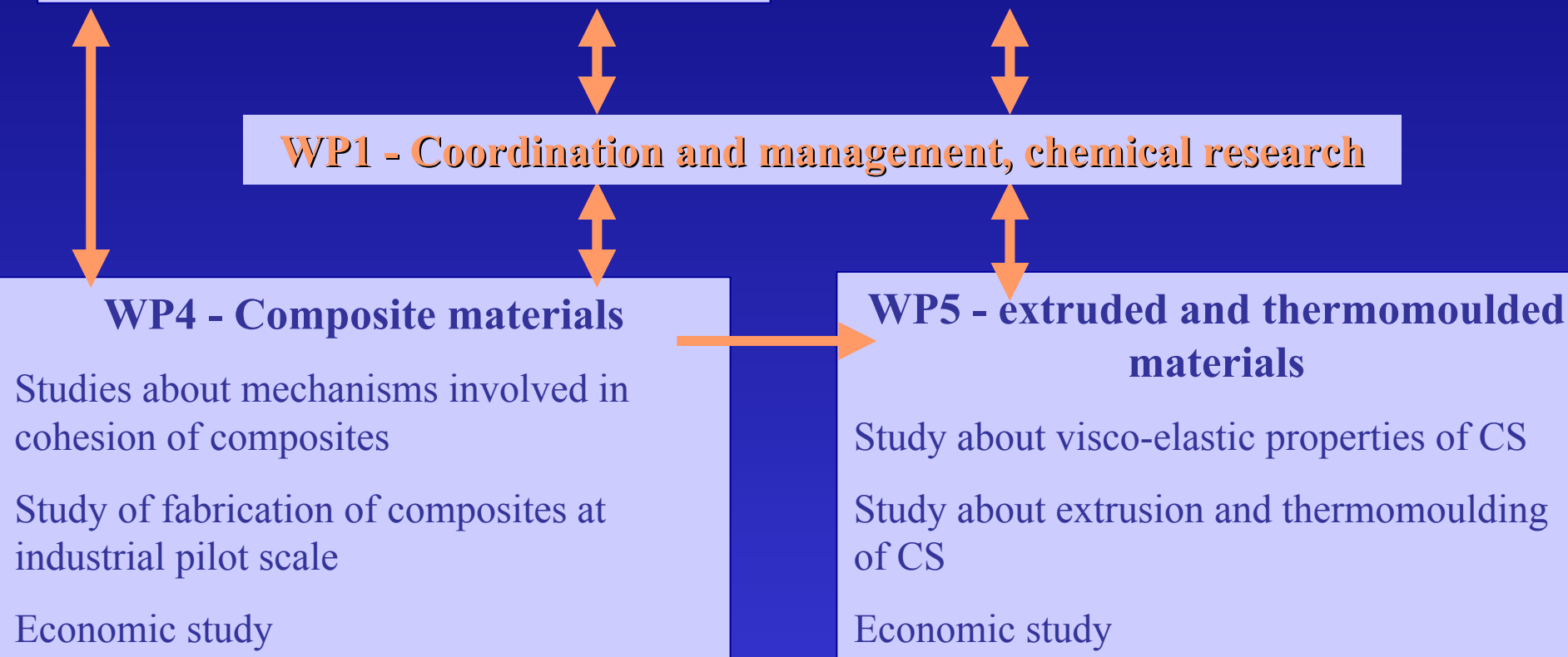
WP1 - Coordination and management, chemical research

WP4 - Composite materials

Studies about mechanisms involved in cohesion of composites
Study of fabrication of composites at industrial pilot scale
Economic study

WP5 - extruded and thermomoulded materials

Study about visco-elastic properties of CS
Study about extrusion and thermomoulding of CS
Economic study



Project cost

Total cost of the project : 1 208 216 euros



Contribution from the Community : 718 000 euros

Welcome to the final workshop of the COTONBIOMAT project