

L'OREAL'S commitment to Green and Sustainable Chemistry



Content :

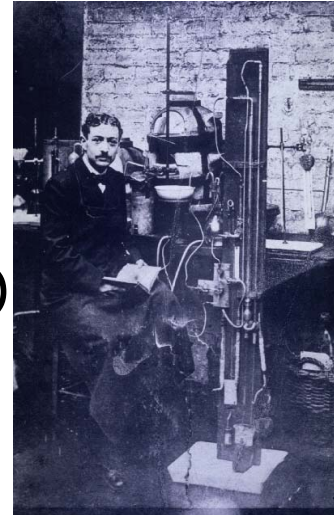
- L'OREAL : GROUP PROFILE, FACTS AND FIGURES
- OUR COMMITMENT TO GREEN AND SUSTAINABLE CHEMISTRY:
 - Our Objectives,
 - Our methodology,
 - Examples of L'Oreal ingredients and process with low environmental impact.



L'OREAL : GROUP PROFILE



- ▶ A “genetically” innovative company
 - in 1907, Eugène Schueller developed the first synthetic “safe hair colourants” (patented in 1908)
- ▶ A century of expertise in cosmetics
- ▶ A worldwide leader in cosmetics
- ▶ Distributed in 130 countries with offices in 58 countries
- ▶ € 17,063 million consolidated sales in 2007
- ▶ 3.3 % of the group’s annual sales devoted to R&D



L'OREAL : RESEARCH & DEVELOPMENT



- ▶ 3095 employees of 61 different nationalities working in 30 different disciplines
- ▶ € 560 million dedicated to cosmetic and dermatological research in 2007
- ▶ 16 research centers across the world and 13 evaluation centers
- ▶ 1/4 of the R&D budget devoted to Advanced Research
- ▶ 132 molecules developed over the last 40 years
- ▶ 576 patents filed in 2007
- ▶ 100 active cooperation agreements with leading academic research

COSMETICS, UNIQUE EXPERTISE

A brand portfolio that is unique in the world



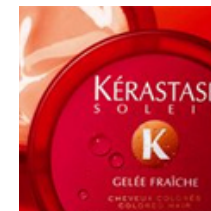
L'ORÉAL
PROFESSIONNEL



REDKEN
210 AVENUE NYC



MATRIX



L'ORÉAL
PARIS



MAYBELLINE
NEW YORK



GARNIER



JOY SHEEN CARSON



VIKTOR & ROLF



LANCÔME
PARIS



BIOTHERM



HELENA RUBINSTEIN



GIORGIO ARMANI
MILANO



RALPH LAUREN



cacharel



Kiehl's
SINCE 1851



shu uemura
tokyo paris new york



VICHY
LABORATOIRES



LA ROCHE-POSAY
LABORATOIRE PHARMACEUTIQUE



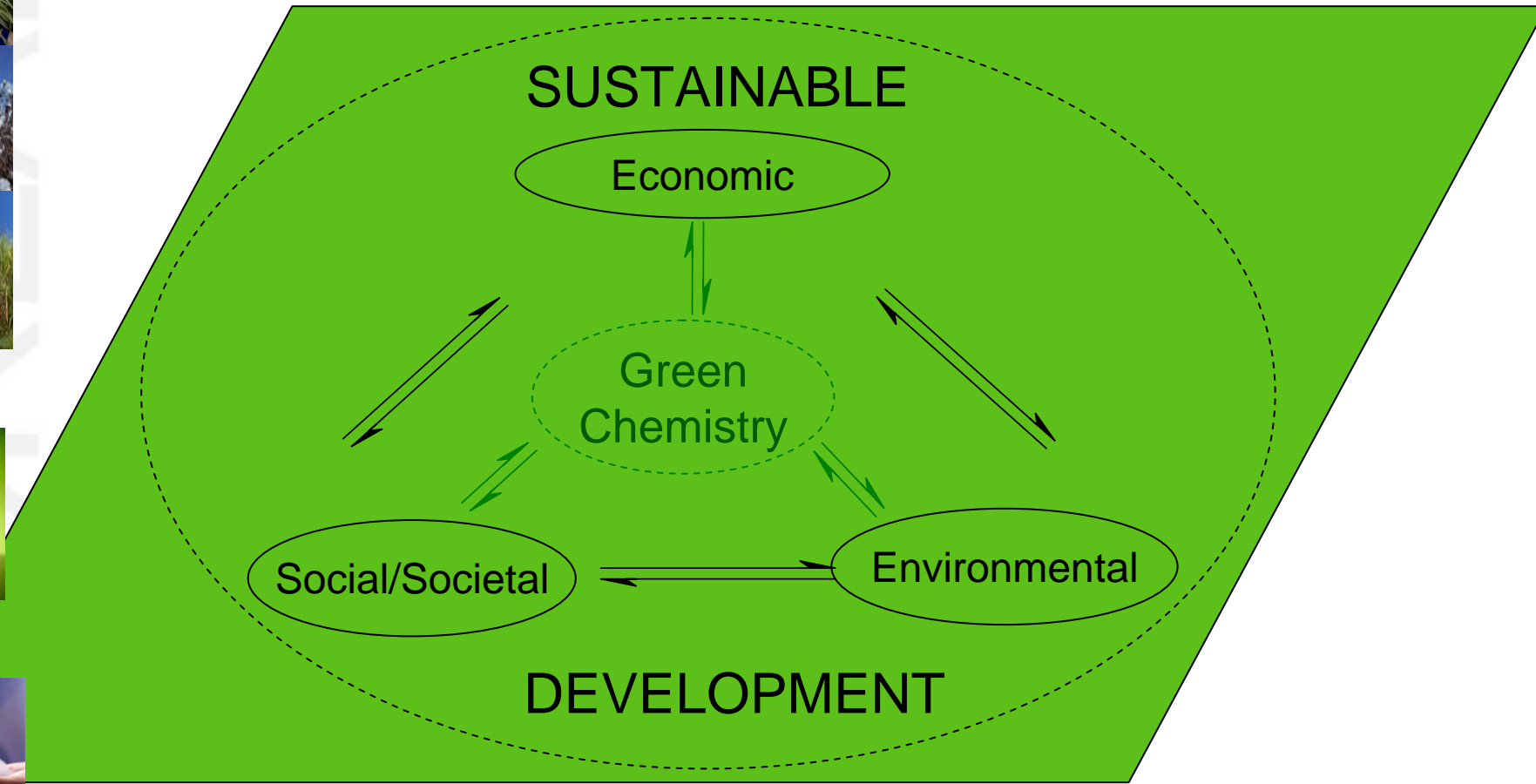
SKINCEUTICALS



SANOFLORE



GREEN CHEMISTRY IS INTEGRATED INTO SUSTAINABLE DEVELOPMENT



WHY L'OREAL'S COMMITMENT TO SUSTAINABLE DEVELOPMENT ?



→ To reduce the impact of our activities on our common heritage by taking into account :

- Health of present and future generations,
- Protection of the environment and biodiversity,
- The concern for fair and responsible trade.

→ To develop the acceptability of our activity

❖ *For more detailed information, consult our Sustainable Development report (Website www.loreal.com)*



WHY L'OREAL'S COMMITMENT TO GREEN AND SUSTAINABLE CHEMISTRY ?



- To ensure maximum human and environmental health and safety,
- To develop sourcing innovation from L'OREAL'S R&D and from the Chemical Industry.

↳ Following the basic principles published by P. T. Anastas and J.C.Warner, greater emphasis is placed on :

- ❖ The use of renewable raw materials from plant,
- ❖ The development of environmentally friendly processes,
- ❖ The manufacture of low ecotoxicity and biodegradable ingredients.

↳ Source of innovative products.



OUR METHODOLOGY TO DEVELOP GREEN AND SUSTAINABLE CHEMISTRY



BASIC IMPORTANCE OF ECO-DESIGN AND MEASUREMENT

BASIC IMPORTANCE OF ECO-DESIGN TO DEVELOP GREEN CHEMISTRY



➤ Eco-design is based on **upstream selection and measurement** :

- ❖ Selection of renewable and eco-friendly starting materials (for instance, valorization of the different parts of a plant to avoid use of raw materials dedicated to food and feed),
- ❖ Measurement of the « greenness » of the chosen processes
- ❖ Assessment of the environmental impact of the new ingredients



OUR GREEN METHODOLOGY IS BASED ON ECO-DESIGN



With the :

- Creation of an **internal database of raw materials from plants** based on the following features of these starting materials :
 - ❖ Available in accordance with Sustainable Development
 - ❖ Renewable
 - ❖ Non - (eco)toxic,
 - ❖ Non - bioaccumulative, non - persistent in the environment
 - ❖ Functional



OUR GREEN METHODOLOGY IS BASED ON ECO-DESIGN



➤ **With the:**

- ❖ **Upstream use of Green indicators such as atom efficiency, E-Factor (waste generated per kg of product, proposed by R.A. Sheldon) to select and develop new green processes (chemical and biocatalytic)**
- ❖ **Assessment of persistence in the environment, bioaccumulation and ecotoxicity (QSAR : Biowin, Kowwin and Ecosar) of our ingredients**
- ❖ **Upstream Assessment of ecotoxicity on daphnia and algae**
- ❖ **Use of cell cultures and reconstructed epidermis models to assess the efficacy and safety of our ingredients**
- ❖ **Development of life cycle analyses**



GREEN METRICS : E-FACTOR



- ❖ To lower it, we measure the E-Factor of our processes from the laboratory scale to the industrial scale :
 - ▶ For instance, E- factors of the highest-volume industrial processes (from 0.36 to 3.3) are low, indicating a low amount of waste.
- ❖ Solvents are included in the calculation of E-Factor, but we also evaluate an E-Factor without solvent to compare the weight of reactants *versus* solvents.



USE OF RENEWABLE RAW MATERIALS FROM PLANTS : OUR COMMITMENT



- ❖ The portfolio of L'OREAL's raw materials originating from L'OREAL'S R&D and Suppliers, includes a high proportion of plant origin :

⇒ in 2007, 40 % of raw materials were sourced from plants.

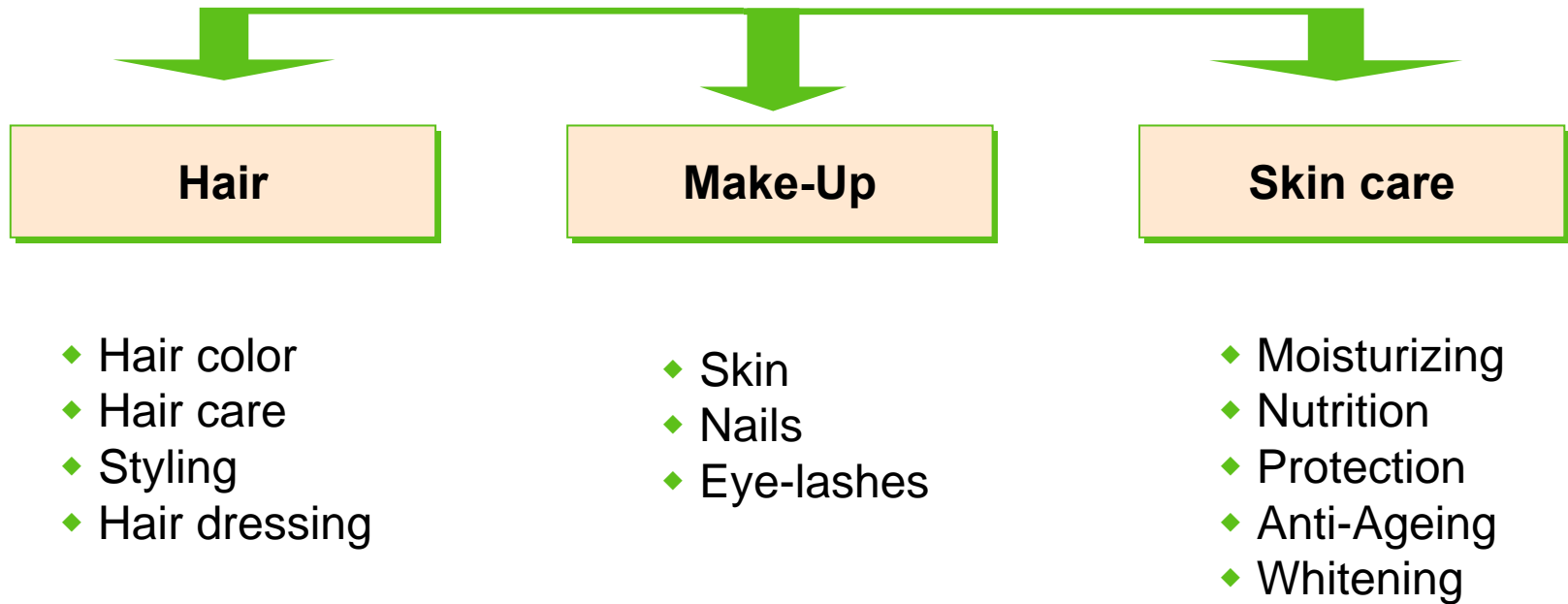
- ❖ In 2005, L'OREAL joined the AGRICE Consortium, French research programme on bioproducts managed by ADEME, French agency for the environment and energy.
- ❖ In 2007 L'OREAL is also participating in the « Synthons » Project within “The Industry and Agro-Resources Hub” (Region of Champagne-Ardenne Picardie). The aim of this project is to develop new green chemical processes from plants (co-valorization).



IMPORTANCE OF RENEWABLE INGREDIENTS IN OUR DIFFERENT LINES IN COSMETICS



OUR MAIN LINES IN COSMETICS



These materials can be used in all lines of products.



WHICH LIPIDS AS RENEWABLE RAW MATERIALS ?



- Oils
- Waxes

→
Hydrolysis

- Fatty acids
- Fatty alcohols

↪ For instance :

◆ Triglycerides

- ◆ Palmitic acid
- ◆ Alcohols C-12 → C-18
- ◆ And derivatives (esters)

□ Advantages

- Fatty phase of cream-formulas (texture)
- Hair and skin protection
- Pigment, powder dispersion
- Application in all lines of Cosmetics.

□ Lines



EXAMPLES OF POLYSACCHARIDES UTILIZED AND THEIR APPLICATIONS



❑ Renewable raw materials

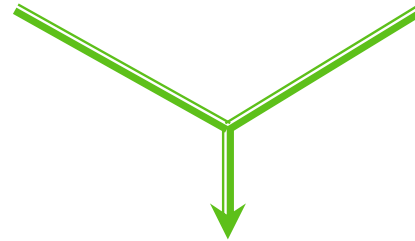
Polysaccharides



Polysaccharide derivatives

- ◆ Cellulose
- ◆ Guar
- ◆ Xanthan

- ◆ Hydroxypropyl cellulose
- ◆ Carboxymethyl cellulose
- ◆ Hydroxypropyl guar



❑ Interest

→ Thickening of aqueous phases.

❑ Lines

→ Formulation for skin and hair care.



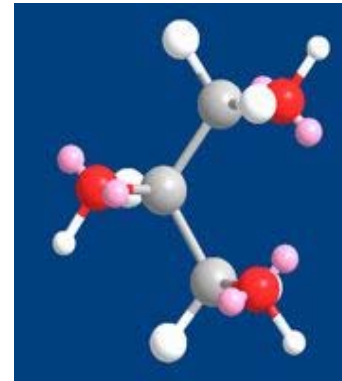
EXAMPLES OF POLYOLS USED AND THE MAIN LINES OF APPLICATIONS



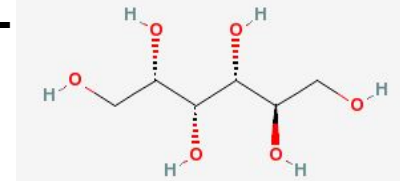
WHICH POLYOLS AS RENEWABLE RAW MATERIALS ?

□ Examples of

GLYCEROL



SORBITOL



□ Interest

→ Key-molecule for skin moisturizing
○ prevention of skin dehydration
○ revitalizing dry skin.

→ Raw material for the synthesis of Ascorbic acid
↓
→ Ascorbic acid is used in antiageing and in whitening formula.

□ Lines

Skin care.



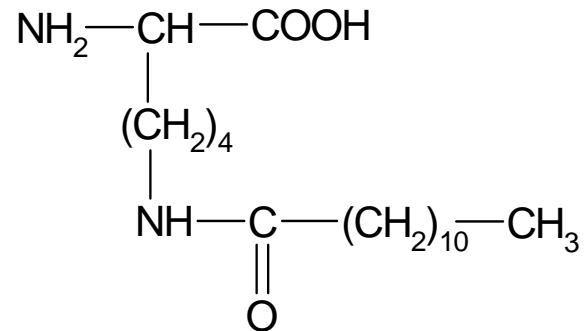
EXAMPLES OF AMINO-ACID DERIVATIVES USED IN COSMETICS



Renewable raw materials

L- Lysine

Fatty-L-lysine



Interest → White adhesive pigment for skin (lamellar structure)

Lines Make-Up.



❖ **SYNTHESIS OF NEW C-GLYCOSIDES**

THROUGH A GREEN PROCESS

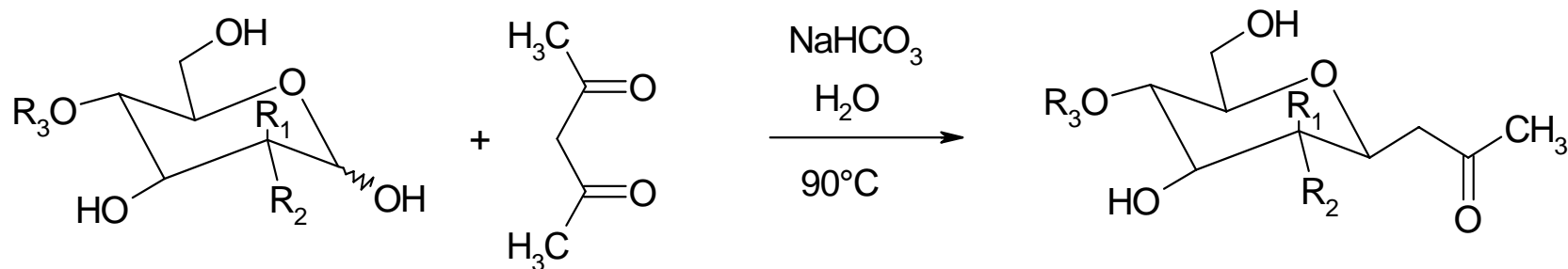
❖ **LAUNCHING OF A NEW GREEN INGREDIENT**

PRO-XYLANE™

USE OF A NEW GREEN PROCESS



Lubineau A. et Coll., Chem. Commun. 2000, 2049-2050

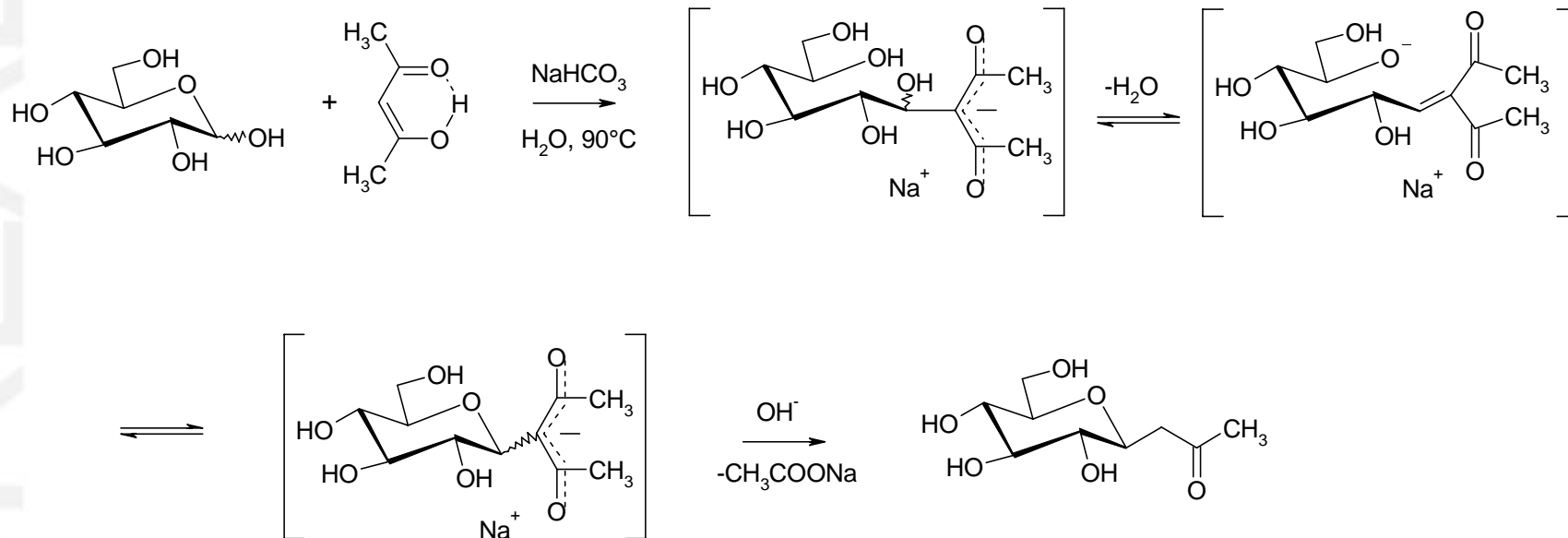


(glucose, mannose, cellobiose)

- Use of renewable raw materials such as monosaccharides and disaccharides.
- In-water reaction (knoevenagel condensation) with quantitative yield.
- Single-step synthesis.
- Opening to new β -C-glycosides.

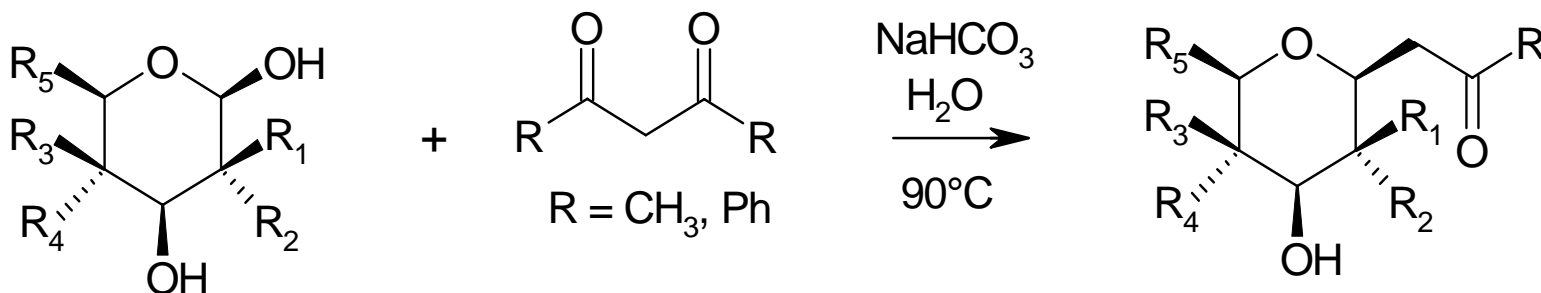


LUBINEAU'S REACTION



Carbohydrate Research 339 (2004) 741-745

A NEW VERSATILE PROCESS DEVELOPED BY L'OREAL R&D

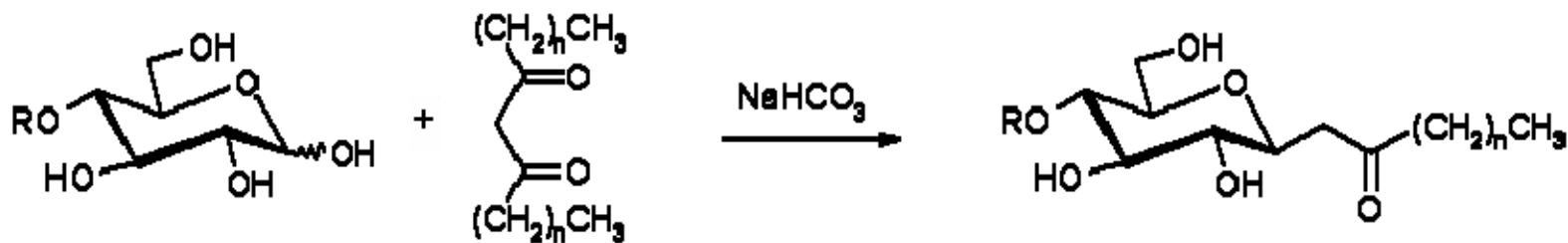
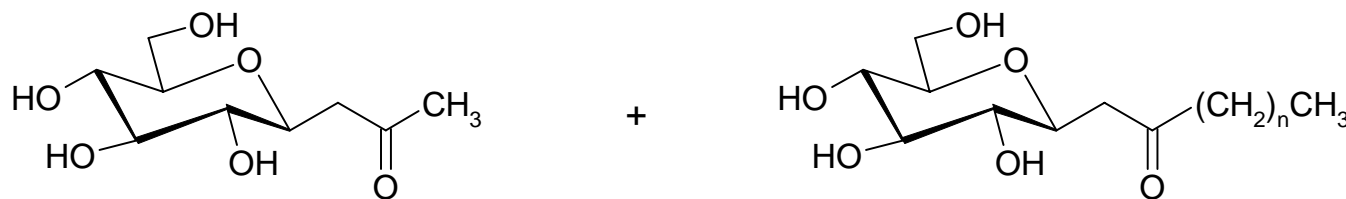
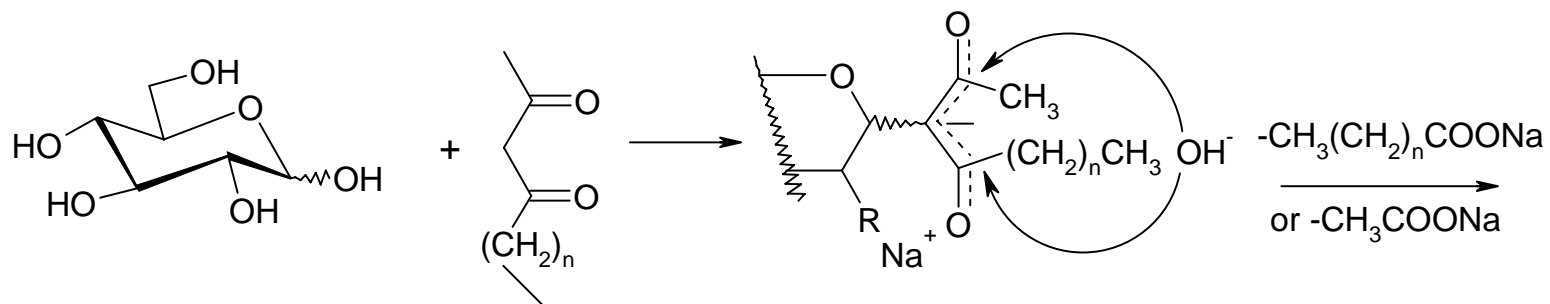


(xylose, lyxose, glucose, galactose)

- Confirmation of the highly valuable reaction on C-5 monosaccharides
- Generally applicable to various stereochemistries of the cycle.
- Great potential for fast scaling-up.
- Direct access to new amphiphilic compounds (long chain R)

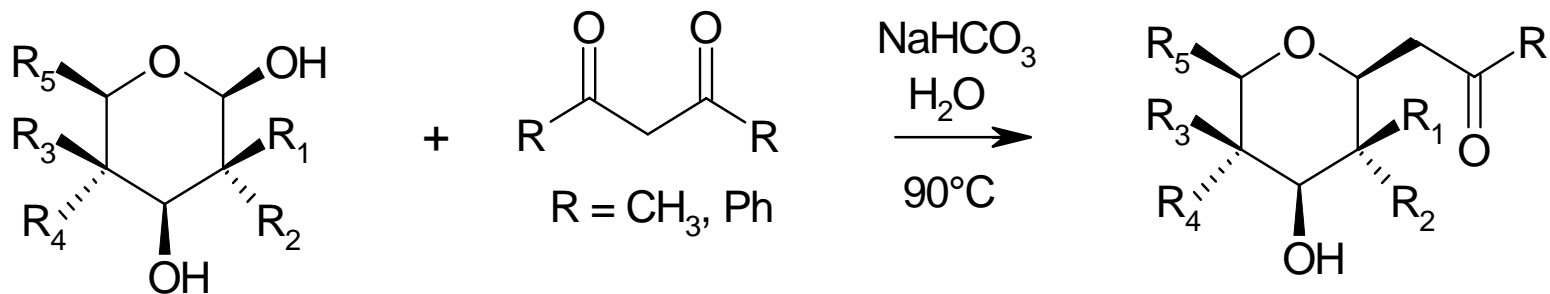
SYNTHESIS OF AMPHIPHILIC COMPOUNDS

(Carbohydrate Research 339, 2004, 741-745, coll. U. Paris XI)



$R = \text{H}$ $n = 0 \text{ à } 8$
 $R = \alpha\text{-D-Glc}$

A NEW VERSATILE PROCESS DEVELOPED BY L'OREAL R&D



(xylose, lyxose, glucose, galactose)

→ Numerous advantages compared to known processes using :

- ❖ electrophilic sugar derivatives such as glycosyl halides or glycols,
- ❖ nucleophilic carbons such as cyanides, enamines or organometallics,
- ❖ several steps to prepare the C – Glycosides

IMPORTANCE OF C-GLYCOSIDES AS ACTIVATORS OF GLYCOSAMINOGLYCANS BIOSYNTHESIS



GAGs and skin ageing :

- Proteoglycans and Glycosaminoglycans (GAGs) of skin play an important role in structural organization of water at a molecular level in dermis, which means a significant contribution :
 - => to the structure of the extra-cellular matrix
 - => to skin moisturizing and elasticity
- The amount of GAGs decreases with ageing thus altering the biomechanical properties of skin.

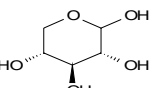
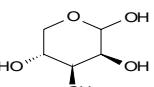
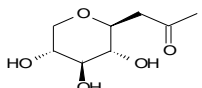
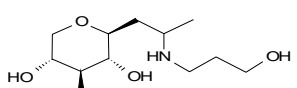
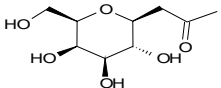
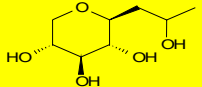
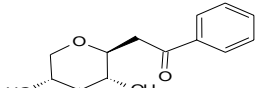
L'Oréal discovery :

- Several C-glycosides are able to stimulate the biosynthesis of GAGs.



POTENTIAL OF C-GLYCOSIDES AS ACTIVATORS OF GAGS BIOSYNTHESIS



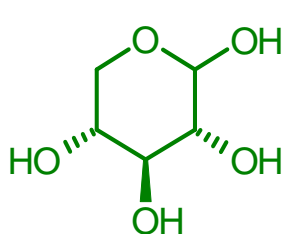
COMPOUND	[C]	%	p
none	-	100	-
TGF β (positive control)	10 ng/mL	348	<0.01
 Xylose	0.5 mM	52	<0.01
	0.1 mM	85	>0.05
	0.02 mM	106	>0.05
 Lyxose	2.0 mM	86	>0.05
	0.4 mM	102	>0.05
	0.08 mM	90	>0.05
 compound 1	10 mM	161	<0.01
	2.0 mM	141	<0.01
	0.4 mM	110	>0.05
 compound 2	1.0 mM	140	<0.01
	0.3 mM	109	>0.05
	0.1 mM	110	>0.05
 compound 3	10.0 mM**	99	>0.05
	3.0 mM	119	>0.05
	1.0 mM	136	<0.01
 compound 4	3.0 mM	218	<0.01
	1.0 mM	169	<0.01
	0.3 mM	139	<0.05
 compound 5	1.0 mM**	95	>0.05
	0.3 mM	102	>0.05
	0.1 mM	120	>0.05

The radioactivity of D-[6-H³]-glucosamine incorporated into the GAGs was quantified.

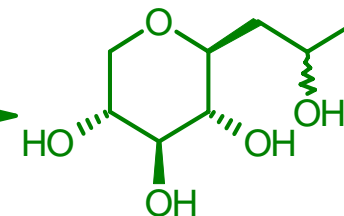
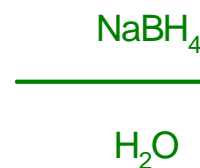
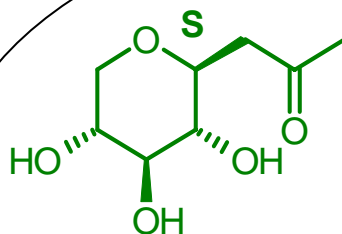
L'Oréal Discovery:

- * β -C-xyloside derivatives are able to stimulate efficiently GAG synthesis.
- * Pro-Xylane™ (Compound 4) has been developed as a new breakthrough in anti-ageing active ingredient

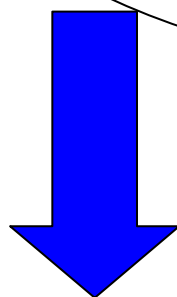
PRO-XYLANE™ SYNTHESIS :



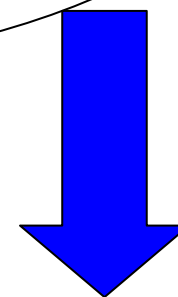
D-Xylose



Pro-Xylane™

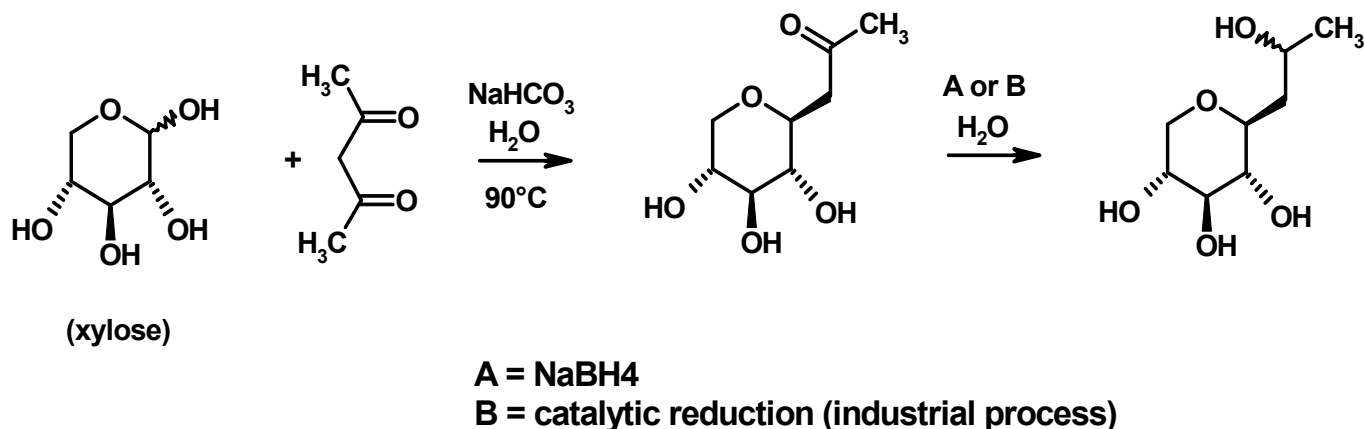


Only β-C-glycoside
(thermodynamic product)



Oily mixture of ~1:1
diastereoisomers

ECOFRIENDLY SYNTHESIS OF PRO-XYLANE™



Following our commitment to Green and Sustainable Chemistry :

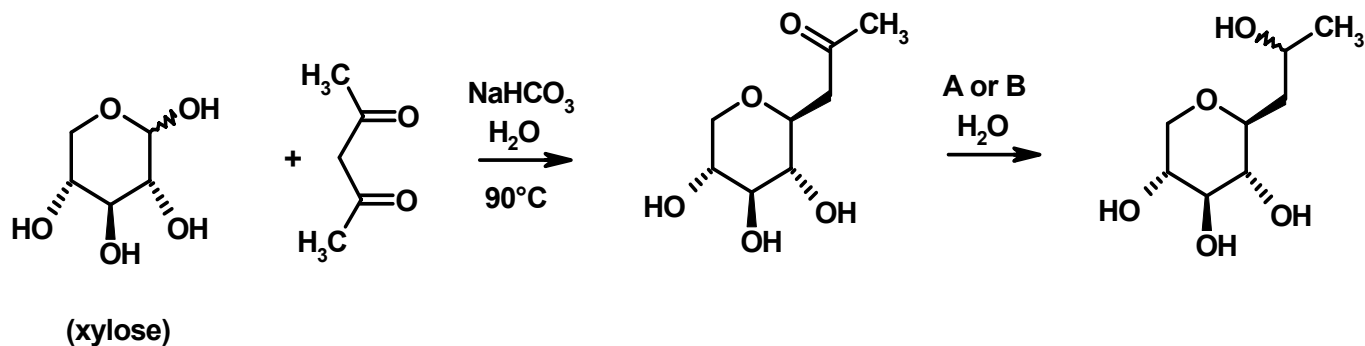
☒ Sustainable Raw Material: Xylose from Beech Wood

☒ Green Process:

=> efficient synthesis (2 steps), use of water as solvent, use of catalysis

☒ Ecofriendly Compound: neither suspected to be persistent (software BIOWIN), nor bioaccumulative (software KIWIN) and nor ecotoxic (software ECOSAR)

ECOFRIENDLY SYNTHESIS OF PRO-XYLANE™



A = NaBH₄

B = catalytic reduction (industrial process)

⇒ Moreover, catalytic reduction B was selected :

⇒ Use of catalytic reduction B (E-Factor = 13 in solution with a tonnage/y less than 100t) enabled us to reduce 60% of waste in 2007 in comparison with reduction A with NaBH₄.



L'OREAL COMMUNICATION ON C-GLYCOSIDES



□ Activation of glycosylaminoglycans and synthesis of Pro-Xylane™ :

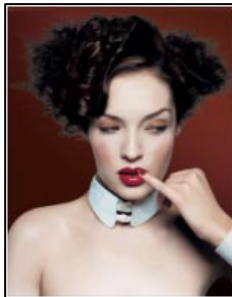
- WO 2002051828 : M. DALKO, L. BRETON (L'OREAL)
- EP 1589010: A. CAVEZZA, S. TROUILLE, P. PICHAUD (L'OREAL)
- Posters: M. DALKO *et al.*
 - 20th World Congress of Dermatology, Paris, July 2002
 - 12th SCI-RSC Medicinal Chemistry Symposium, UK, September 2003
 - 13th European Symposium on Organic Chemistry, Cavtat-Dubrovnik (Croatia), September 2003
- Bioorganic & Medicinal Chemistry Letters : M. DALKO *et al.*
Online publication complete: 8-JAN-2009 DOI information :
10.1016/j.bmcl.2008.12.037

□ C-glycosides as amphiphiles :

- WO 2002051803 : M. PHILIPPE, D. SEMERIA (L'OREAL)
- Carbohydrate Research 339 (2004) 741-745 : Y. HERSANT, R. ABOU-JNEID, Y. CANAC, A. LUBINEAU, M. PHILIPPE, D. SEMERIA, X. RADISSON and M-C. SCHERRMANN



ACKNOWLEDGEMENTS



– L'OREAL Research and Development

– Pr. LUBINEAU's team at Paris-Sud University

*And thank you for your
attention*

