NATURAL POLYMERS 4
Proteins' Fibres III
ELASTIN

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Where is ELASTIN found in the Human Body?

- Great amount of the **ELASTIN** is found in the Blood Vessel near to the Heart, further in the Ligaments, in the Skin and in the Tendons.
- **Elastin** is the not soluble **Scleroprotein**, its Name is derived from its elastic Properties
- **Scleroprotein** is the Denomination for the any Protein having approximately the fibrilar Shape
- **Scleroprotein** are Water insoluble and e.g. **Elastin,** Keratin and Fibroin belong to this Group

What is the Difference between ELASTIN and COLLAGEN

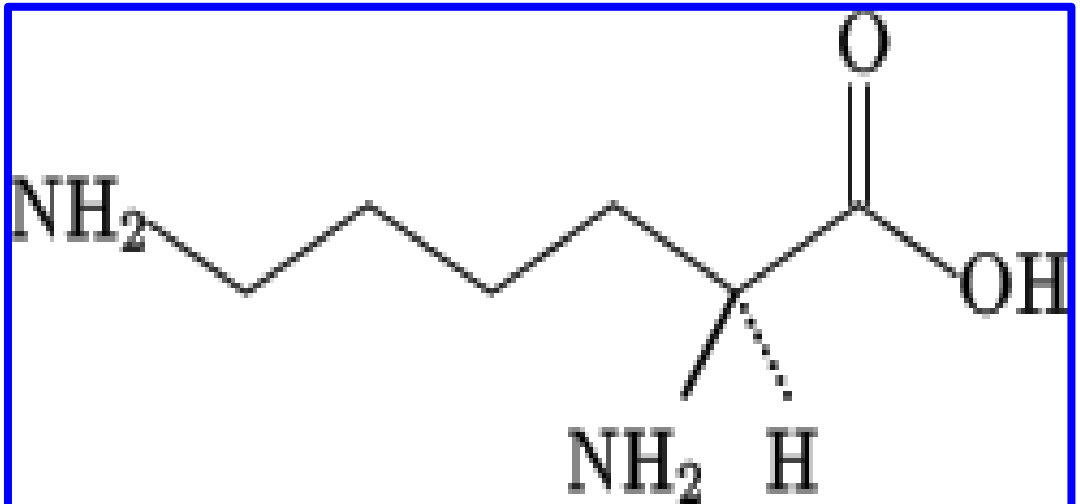
- **COLLAGEN** is the crystalline α helix, creating whole Hierarchy of Structures from the primary > secondary > tertiary > quaternary
- **ELASTIN** is AMORPHOUS CROSSLINKED **Scleroprotein**, which does not creating Helixes (neither α no β) neither β Sheets

ELASTIN – the primary Structure 1

- Composition of the **ELASTIN** is rich in Amino acids, especially in **GLYCINE**, **ALANINE, PROLINE, VALINE** and **LEUCINE.**
- **ELASTIN** contains also relatively **many basic Lysine's Rests** and **ELASTIN** has therefore Isoelectric Point lower than 10.

LYSIN

(Lys, K)



ELASTIN – primary Structure 2

Amino acids' Composition of the TROPOELASTIN
The Number of the Particular Amino acids the Molecule

Asparagine	2	Proline	87	Leucine	37
Hydroxyproline	9	Glycine	267	Thyrosine	13
Serine	8	Alanine	174	Phenylalanine	22
Glutamine	15	Valine	97	Lysine	38
Threonine	11	Isoleucine	15	Arginine	6

ELASTIN – primary Structure 3

Two Sequences LAAALAAL or LAALAAAL are necessary for the Creating the Bond between the ELASTIN Molecules of the ELASTIN

Approx. 400 Amino acids

+ GGVIG---LAALAAAL---LAALAAAL----------LAALAAAL---G-----

> 150 < Amino acids

Marking of the Amino acids in this Sequence above:

G – Glycine, V – Valine, I – Isoleucine, L – Lysine, A - Alanine

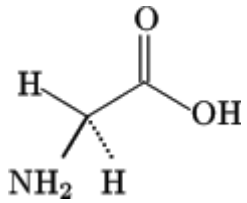
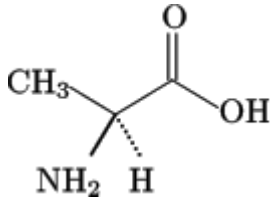
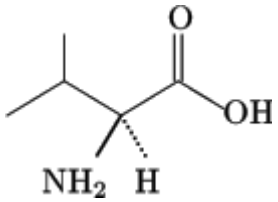
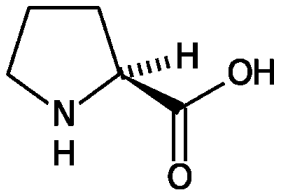
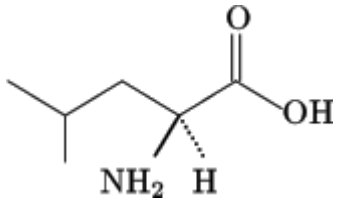
Sequences which are able to create the Bonds between the ELASTIN Molecules are separated by approx. 150 Amino acids

The RIGHT MARKING IS: Lysine K, and not L! L is the RIGHT MARKING for LEUCIN

ATTENTION! The right one Letter Marking for the LYSINE (K) is not used here!

ELASTIN Molecule is created of approx. 400 Amino acids

Biogenic Amino acids

Glycine (Gly, G)	
Alanine (Ala, A)	
Valine (Val, V)	
Proline (Pro, P)	
Leucine (Leu, L)	

A **biogenic amine** is a biogenic substance with one or more amine groups. They are basic nitrogenous **compounds formed mainly by decarboxylation of amino acids** or by amination and transamination of aldehydes and ketones. Biogenic amines are organic bases with low molecular weight and are synthesized by microbial, vegetable and animal metabolisms. In food and beverages they are formed by the enzymes of raw material or are generated by microbial decarboxylation of amino acids

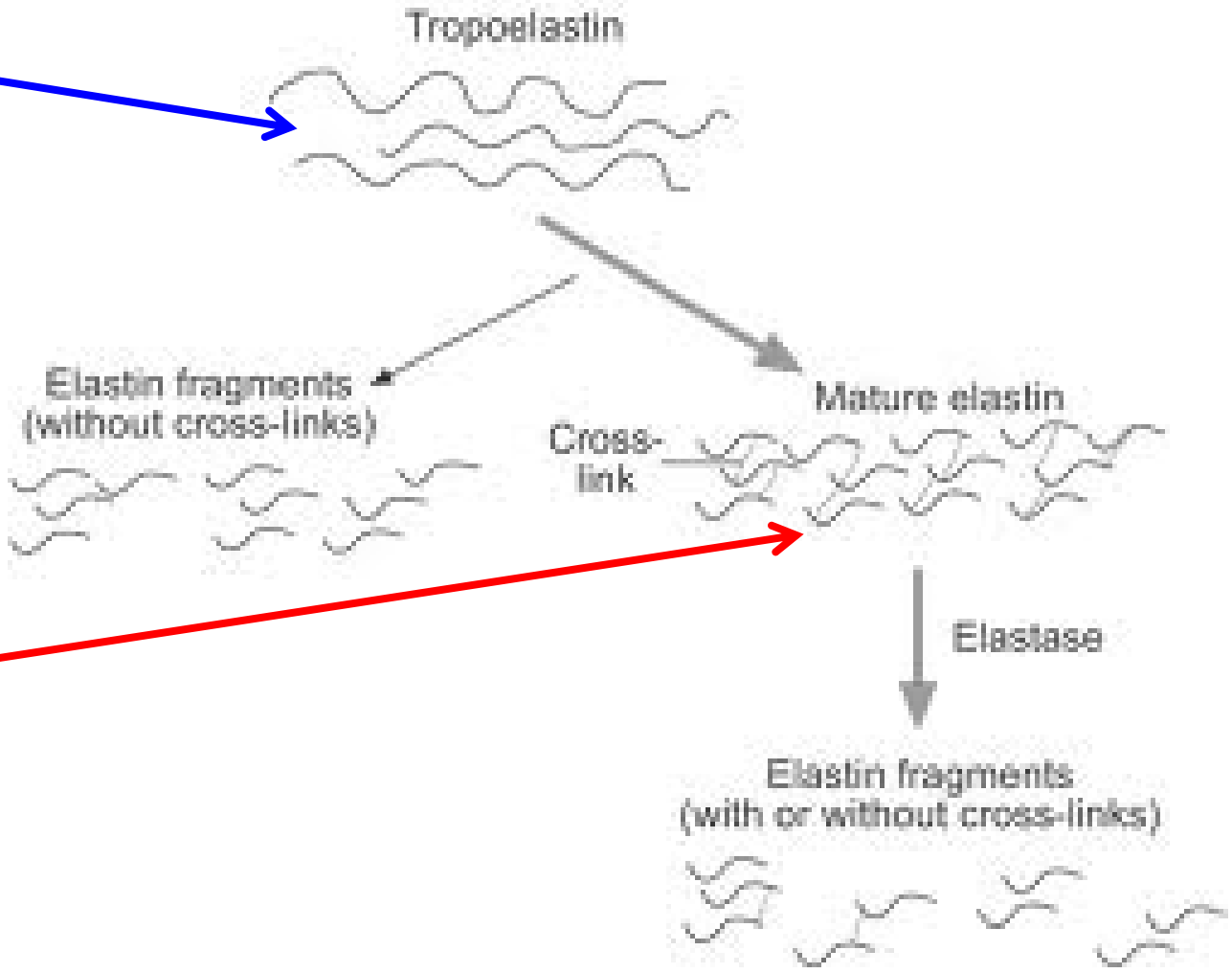
Importance in food

Biogenic amines can be found in all foods containing proteins or free amino acids and are found in a wide range of food products including fish products, meat products, dairy products, wine, beer, vegetables, fruits, nuts and chocolate. In non-fermented foods the presence of biogenic amines is mostly undesired and can be used as indication for microbial spoilage. In fermented foods, one can expect the presence of many kinds of microorganisms, some of them being capable of producing biogenic amines.

They play an important role as source of nitrogen and precursor for the synthesis of hormones, alkaloids, nucleic acids, proteins, amines and food aroma components. However, food containing high amounts of biogenic amines may have toxicological effects.

What is creating the Crosslinking in the ELASTIN

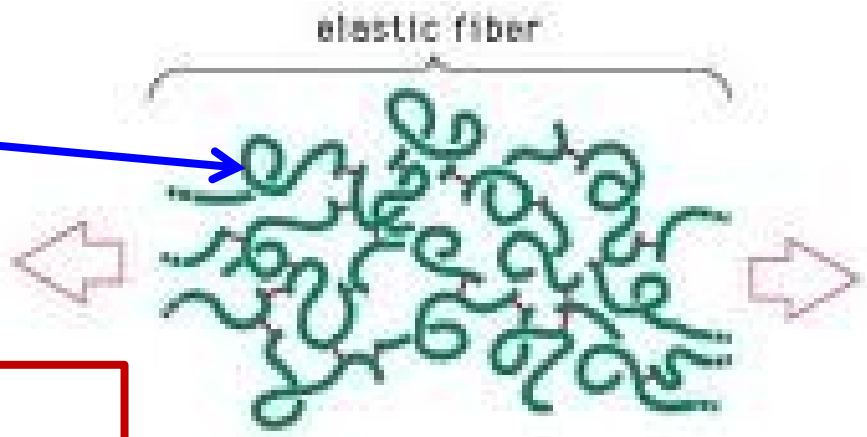
TROPOLELASTIN keeps partially its **GLOBULAR STRUCTURE**



ELASTIN has after Crosslinking mainly the FIBRILAR STRUCTURE already

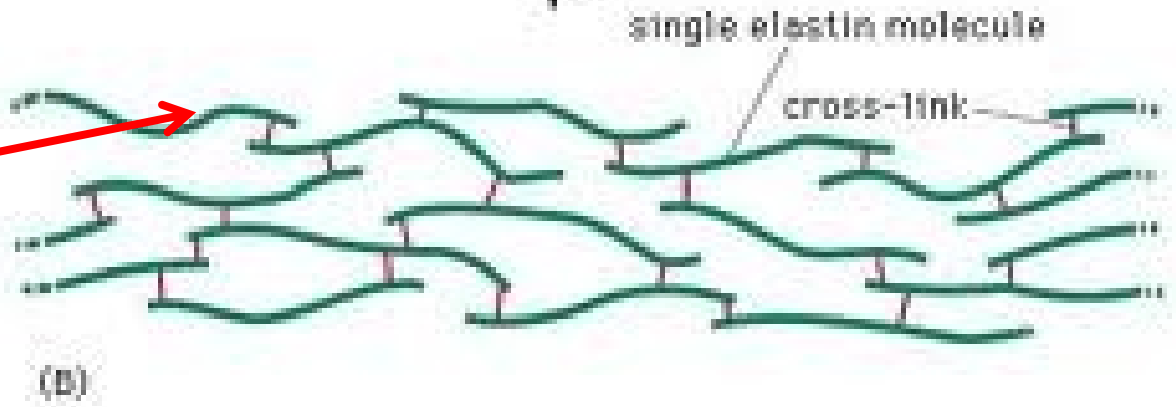
Reversible Deformation of the ELASTIN

ELASTIN keeps partly its GLOBULAR STRUCTURE before Deformation



ELASTIN is elastic in the HYDRATED STATE only, it is not so for the Dry **ELASTIN !**
Water acts as a LUBRICANT between the **ELASTIN** Molecules.

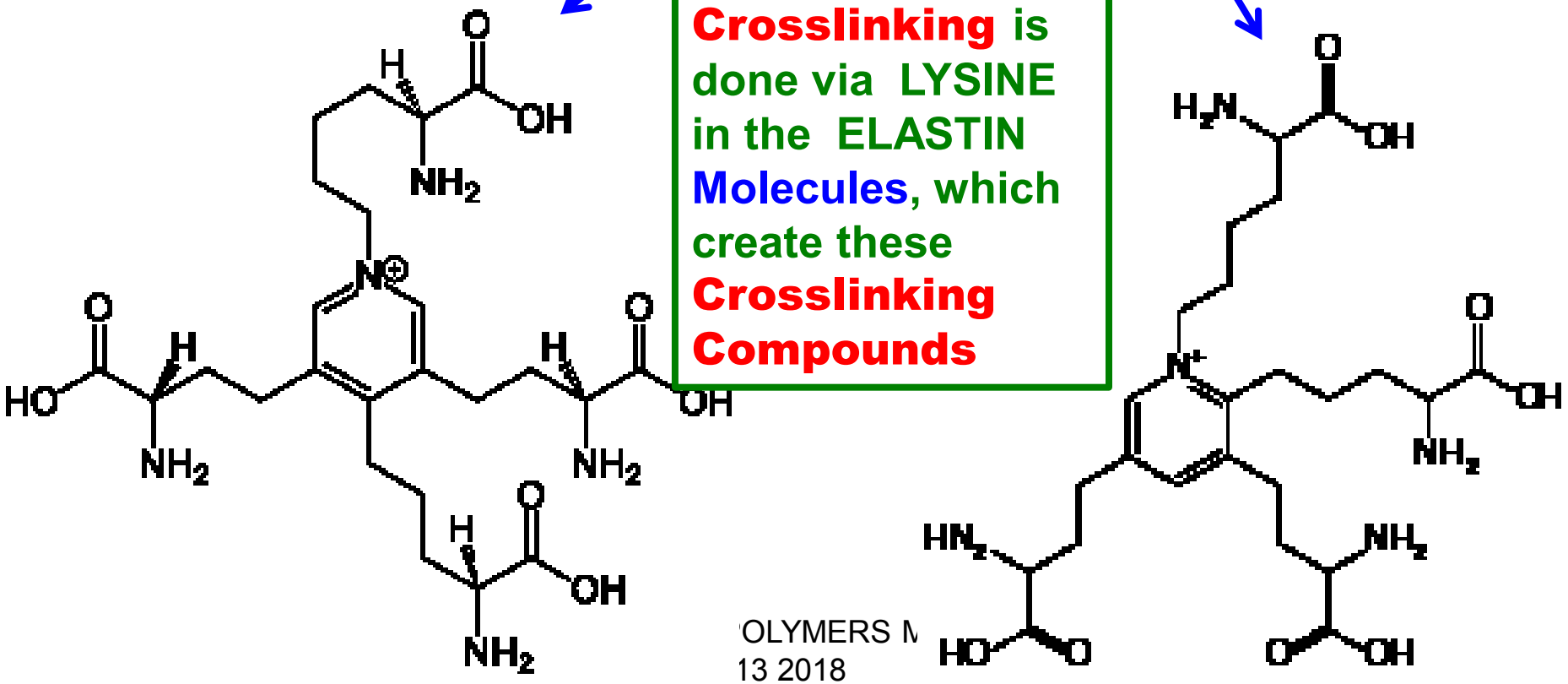
ELASTIN has mainly the FIBRILAR STRUCTURE after the DEFORMATION



It resembles VULCATISATION of the RUBBER! The RUBBER is also reversible crosslinked.

What is the PRINCIPLE of the ELASTIN'S Elasticity

- The smaller Molecules so called **TROPOELASTIN** are crosslinked by assistance of the **ENZYMATIC CATALYSIS by the Desmosine** and **Isodesmosine** Molecules

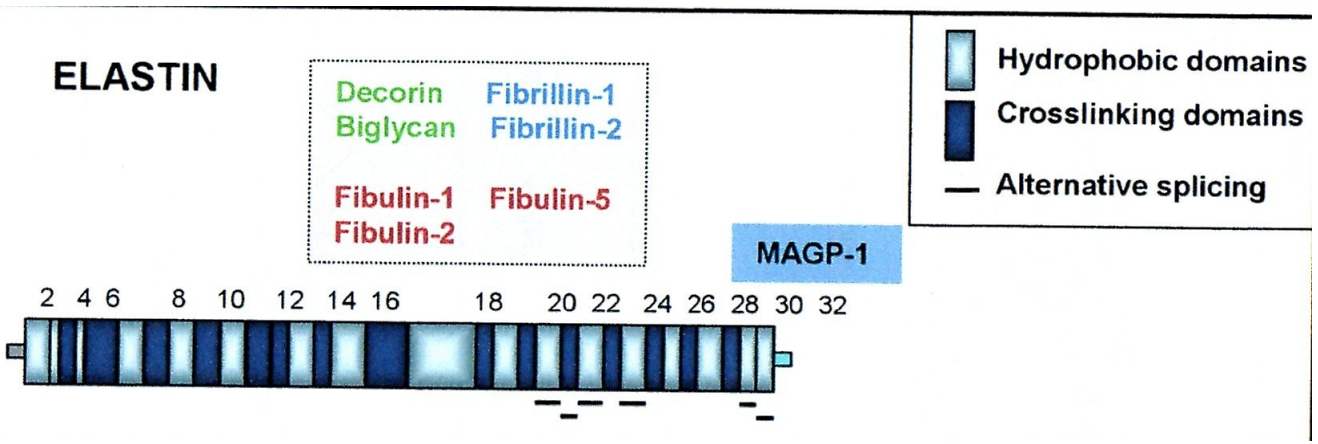


Crosslinking is done via LYSINE in the ELASTIN Molecules, which create these **Crosslinking Compounds**

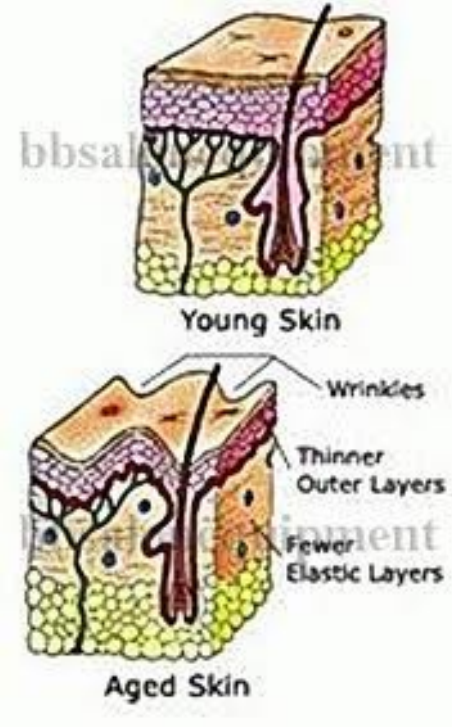
What is creating the actual ELASTIC FIBRE

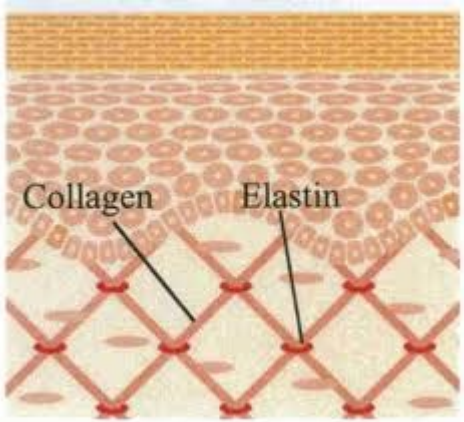
Fibrillin is a glycoprotein, which is essential for the formation of elastic fibers found in connective tissue. Fibrillin is a major component of the microfibrils that form a **sheath** surrounding the amorphous elastin.

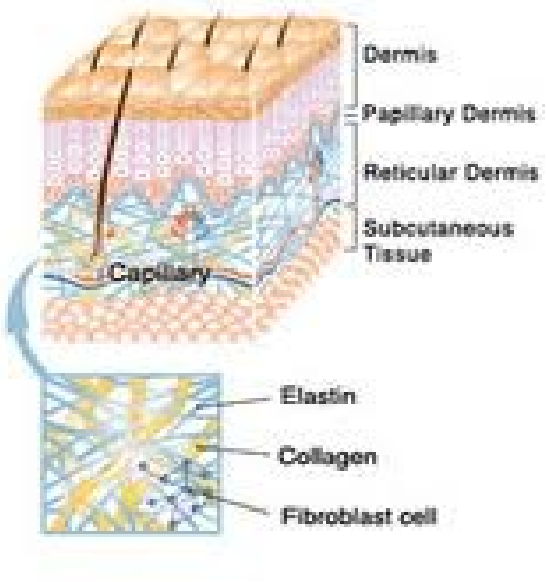
Fibrillin + Elastin



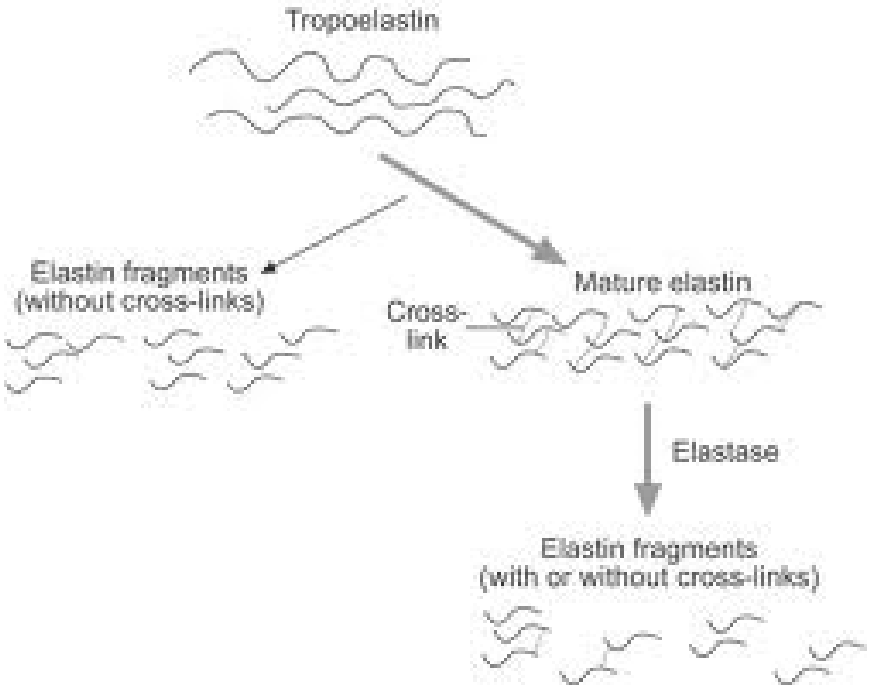
ELASTIN in the Human Skin



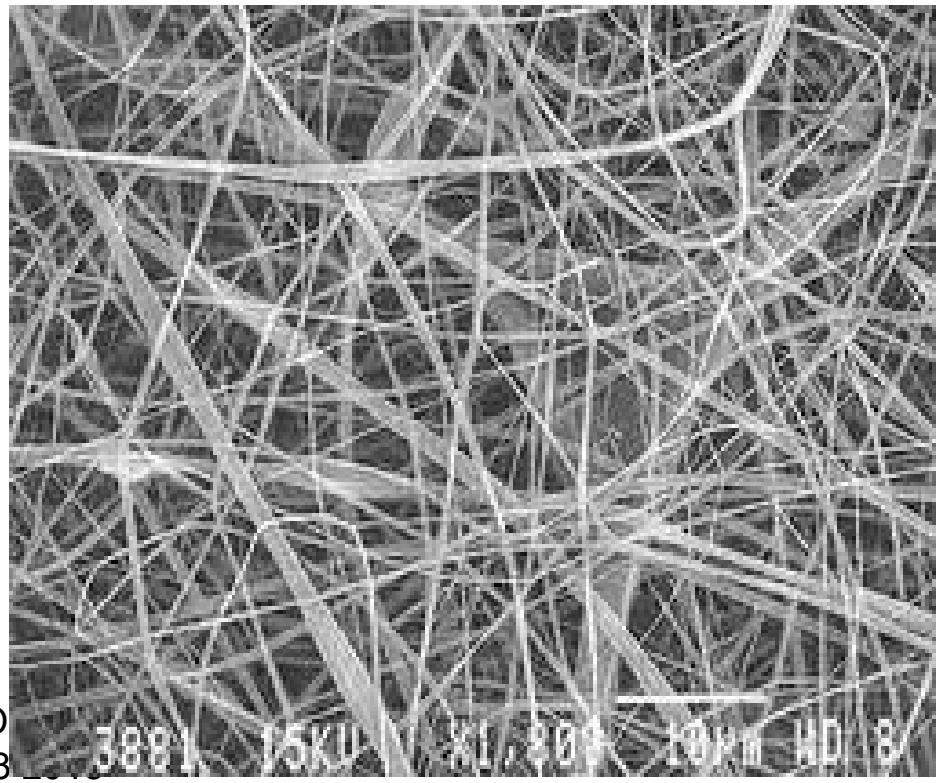




ELASTIN in the Human Skin



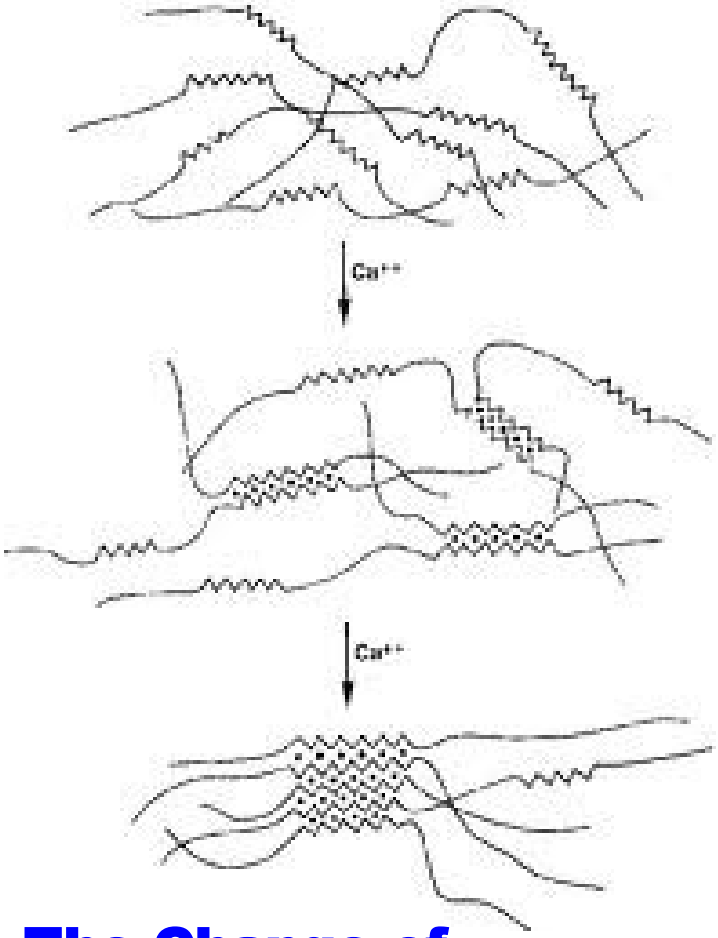
The Skin growing old or the old Skin is not more able to create the elastic Fibres of the ELASTIN in the Human Skin already. These Fibres are cleaved by Enzyme ELASTASE. The Skin is loosing its Elasticity and the Wrinkles ate created ….



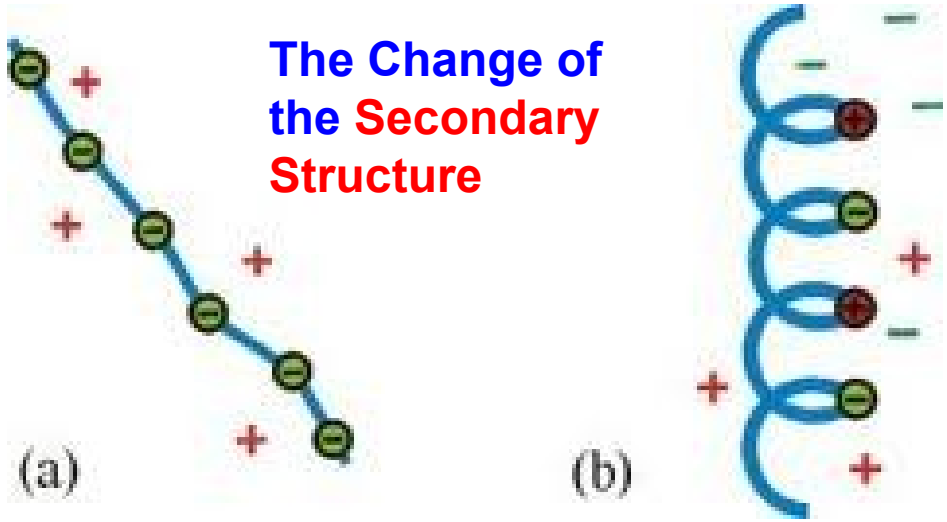
COACERVATION

- **COACERVATION is the REVERSIBLE PROCESS, when the Secondary Structure of the Polymer Chain is changed**
- **These changed Secondary Structures can then create by Aggregation the Reversible Tertiary Structures**
- **These changed Structures are called COACERVATE**

COACERVATION of the TROPOELASTINE



The Change of the TERTIARY STRUCTURE

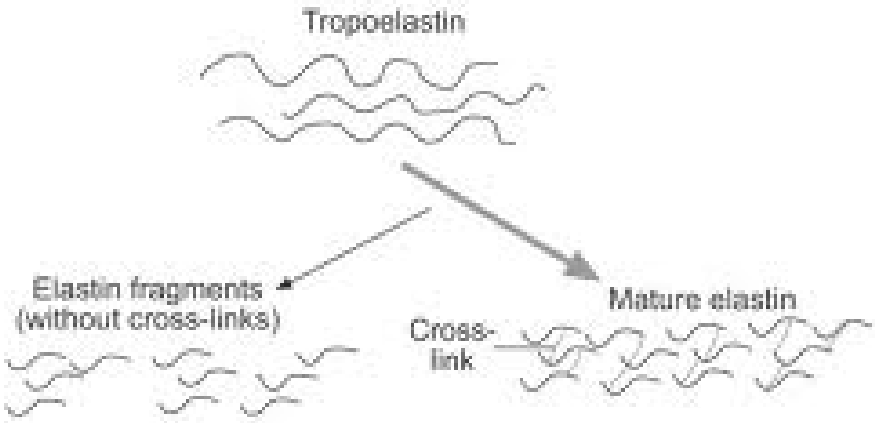


The Change of the Secondary Structure

THESE PICTURES ILLUSTRATE THE TERMS „COACERVATION and COACERVATE „ ONLY.
They are not related directly to ELASTIN.

Tropoelastin aggregates at physiological temperature due to interactions between hydrophobic domains. This process is reversible and thermodynamically controlled.

TROPOLELASTIN > ELASTIN > α ELASTIN



ELASTIN is very resistant from the chemical Point of Viiew. For Example, it is resistant to the short Time Action of the 80 % w/w H_2SO_4 or 4-N NaOH.

The so called α **ELASTIN** (MW » 60000 - 80000) is Water soluble after partial Hydrolysis. The α **ELASTIN can then associate by some Chain Sequences > COACERVATION**

β **ELASTIN** arises from the **ELASTIN** after the very intensive scission besides the α **ELASTIN.**

COACERVATION does not occur for the β **ELASTIN ,** probably its Molecules are too short (MW ≈ 5000) and they are not rich enough of the Sequences able to form the Associates

Standard ELASTIN is not able to do COACERVATION

ELASTIN in the HIDE & LEATHER

- **The TECHNICAL IMPORTANCE of the ELASTIN is low in general**
- **ELASTIN** forms the smaller Part then the COLLAGEN in the Hide, occurring in the outer Part of the Hide and in the Under hide connective tissue
- **ELASTIN** is resistant to the most technological Steps of the Hide Tannin to Leather, except for the enzymatic Bate
- **ELASTIN** can contribute to the Leather Elasticity, abut there are not common View on this Phenomena. Some View exist, the **ELASTIN** should be removed during Tannin.
- Analytical Monitoring of the **ELASTIN** after Tannin is based on the Determination of the VALINE after Hydrolysis of the Leather, because there are approx. 18 % w/w of the VALINE there (the highest Concentration in all the Proteins)

The Importance of the ELASTIN in the Nutrition

- **ELASTIN** has the low Importance **in the Nutrition** due to its chemical and enzymatic Resistance, this Protein is hardly to be digest
- **ELASTIN** must be cleaved by enzymatic or chemical partly cleaved if should be used the Animal Feed