L2 – Enzyme applications

Enzyme Science and Engineering

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Enzyme applications

1. **Starch conversions**
   - Production of glucose syrup
   - Production of high fructose corn syrup
   - Production of high maltose conversion syrups
   - Production of cyclodextrins
   - Production of ethanol
2. **Lignocellulosic Biomass conversions**
   - Cellulose conversion
   - Hemicellulose conversion
   - Lignin conversion

3. Enzymes in the Production of Functional Oligosaccharides and Other Neutraceuticals
4. Enzymes in the Modification of Fats and Oils
5. Enzymes in the Animal Feed Industry
6. Enzymes in the Pulp and Paper Industry
7. Enzymes in the Fruit Juice Processing Industry
8. Enzymes in the Meat and Fish Processing Industry
9. Enzymes in the Dairy Industry
10. Enzymes in Detergents
11. Enzymes in the Leather Industry
12. Enzymes in the Production of Bulk and Fine Chemicals
13. Analytical Applications of Enzymes
14. Enzyme-Replacement Therapy

What are enzymes?

- Enzymes are proteins
- Catalysts are those that accelerate reaction without getting altered permanently
- Sometimes RNA’s have enzymatic property
- 3D structure of proteins allows them to have this unique

Functional property

- Enzyme are purified from
    - Animals, e.g., Rennet
    - Plants, e.g., Papain
    - Microbial sources, e.g., Cellulases

Why enzymes are useful?

There are several characteristics of enzymes that make them ideal for industrial applications:

- Specificity: Enzymes are highly specific in their catalytic activity, meaning that they can catalyze a specific chemical reaction without affecting other reactions. This allows them to be used in targeted and precise ways in industrial processes.
- Efficiency: Enzymes can catalyze reactions at much lower temperatures and pressures than traditional chemical catalysts, making them more energy-efficient and cost-effective.
- Stability: Enzymes are relatively stable and can be used over a wide range of pH and temperature conditions. This makes them suitable for use in a variety of industrial processes.
- Renewability: Enzymes are biodegradable and can be produced sustainably, making them an environmentally friendly alternative to traditional chemical catalysts.
- Versatility: Enzymes can be used in a wide range of industries, including food processing, animal feed, textiles, paper and pulp production, and detergent manufacturing. This makes them a valuable tool in many different industrial applications.

Enzyme classification

ENZYME CLASS	INDUSTRIAL ENZYMES
EC 1: Oxidoreductases	catalase
	glucose oxidase
	laccase
EC 2: Transferases	glucosyltransferase
EC 3: Hydrolases	amylase
	cellulase
	lipase
	mannanase
	pectinase
	phytase
	protease
	pullulanase
	xylanase
EC 4: Lyases	pectate lyase
	alpha-acetolactate decarboxylase
EC 5: Isomerases	glucose isomerase
EC 6: Ligases	not used at present

Availability of enzyme!

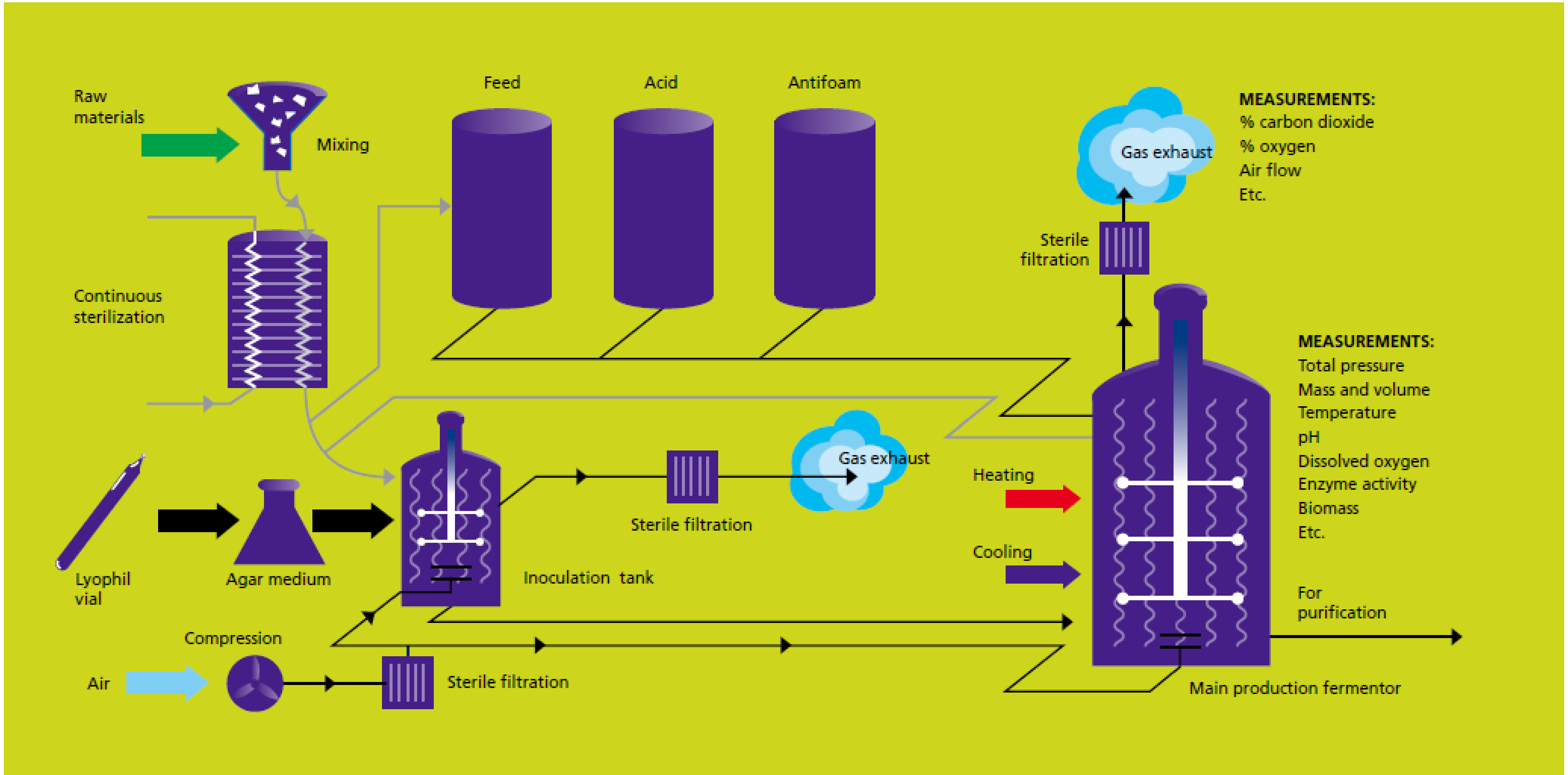


Fig. 1. A conventional fermentation process for enzyme production.

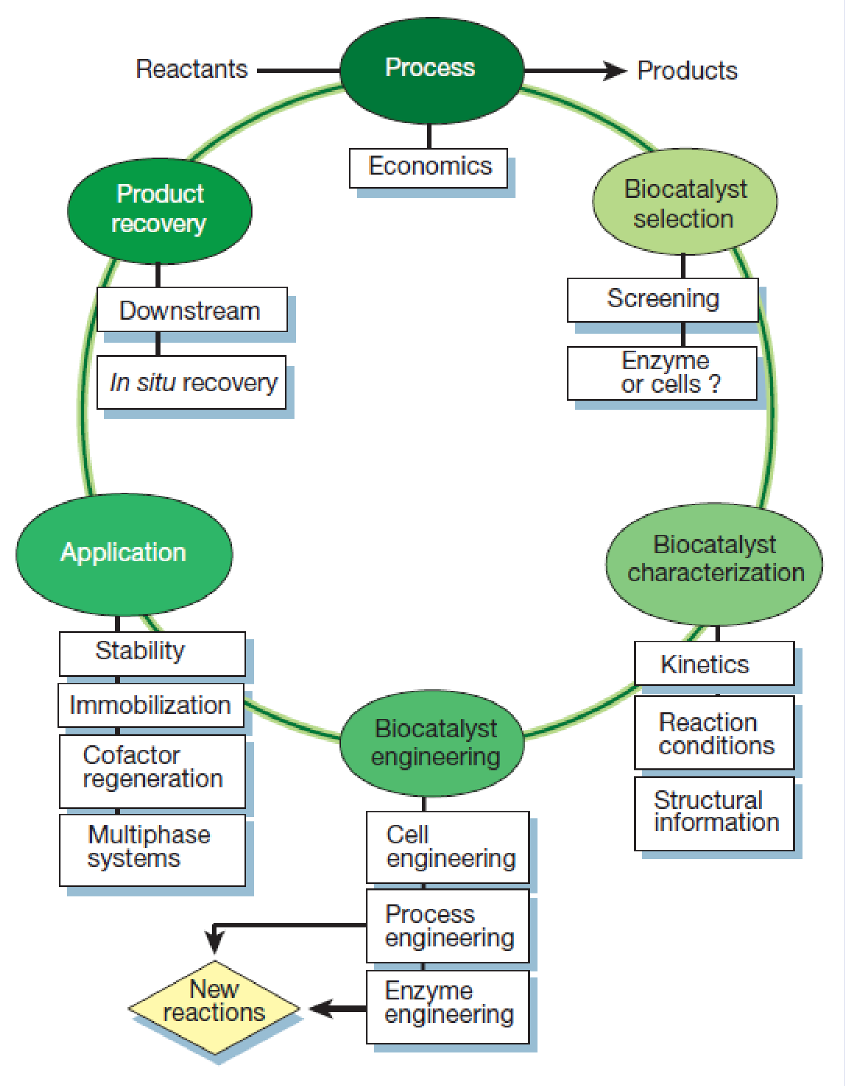


Figure 1 The biocatalysis cycle.

NOOR ENZYMES
WORLD OF ENZYMES

TEXTILE ENZYMES

- **For Cotton and Hosiery Biopolishing**
- For Cotton and Denim Biofading
- For Textile and Denim Desizing
- For Textile Fabric Bioscouring
- Concentrated Thermostable Alpha Amylase
- Concentrated Low Temperature Alpha Amylase
- Concentrated Cellulase for Formulation (Biopolishing)
- Concentrated Cellulase for Formulation (Biofading)
- Concentrated Pectinase for Formulation (Bioscouring)
- Concentrated Catalase for Formulation (Peroxide Killer)

LEATHER ENZYMES

- For Beamhouse Soaking
- For Fat and Oil Degreasing
- For Acid Bating and Softening
- For Alkaline Bating and Dewrinkling
- For Enzymatic Dehairing
- Concentrated Alkaline protease for Formulation
- Concentrated Acid Protease for Formulation
- Concentrated Alkaline Lipase for Formulation
- Concentrated Acid Lipase for Formulation

STARCH ENZYMES

- For Starch Liquefaction
- For Starch Saccharification
- For Viscosity Reduction
- For Dextran Hydrolysis

ANIMAL FEED ENZYMES

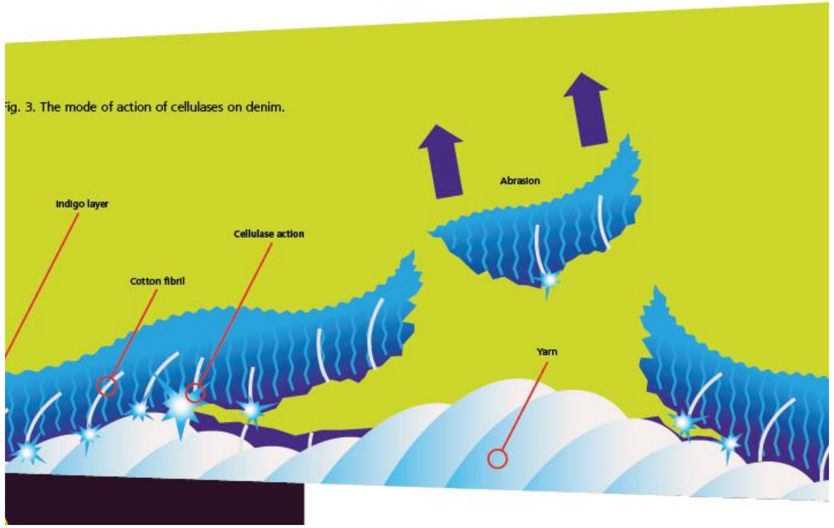
- Phytase Enzyme for Animal Feed
- B-Glucanase Enzyme for Animal Feed
- Cellulase Enzyme for Animal Feed
- Xylanase Enzyme for Animal Feed
- Amylase Enzyme for Animal Feed
- Bacterial Protease Enzyme for Animal Feed
- Fungal Protease Enzyme for Animal Feed
- Lipase Enzyme for Animal Feed

DIETARY SUPPLEMENT ENZYMES

- Fungal Amylase Enzyme for Dietary Supplements
- Fungal Xylanase Enzyme for Dietary Supplements
- Fungal Lipase Enzyme for Dietary Supplements
- Fungal Protease Enzyme for Dietary Supplements
- Fungal Cellulase Enzyme for Dietary Supplements

Cloth Industry

Faded Jeans



ig. 3. The mode of action of cellulases on denim.

cellulase

Enzymatic desizing of cotton fabric

Enzymatic desizing is a method for removing the size, or starch, from cotton fabric.

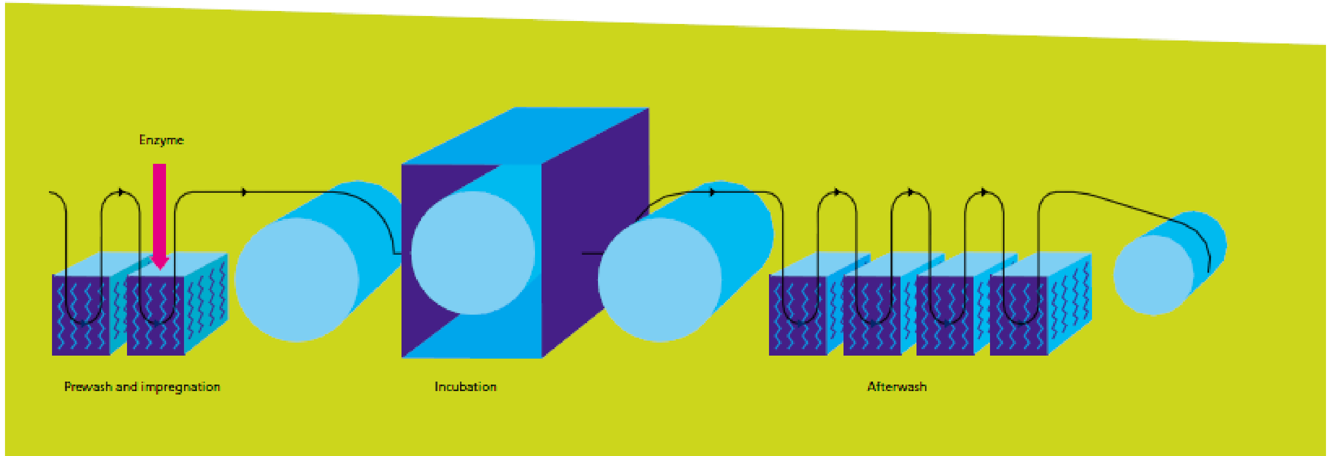


Fig. 2. A pad roll process.

Enzymes as detergents!

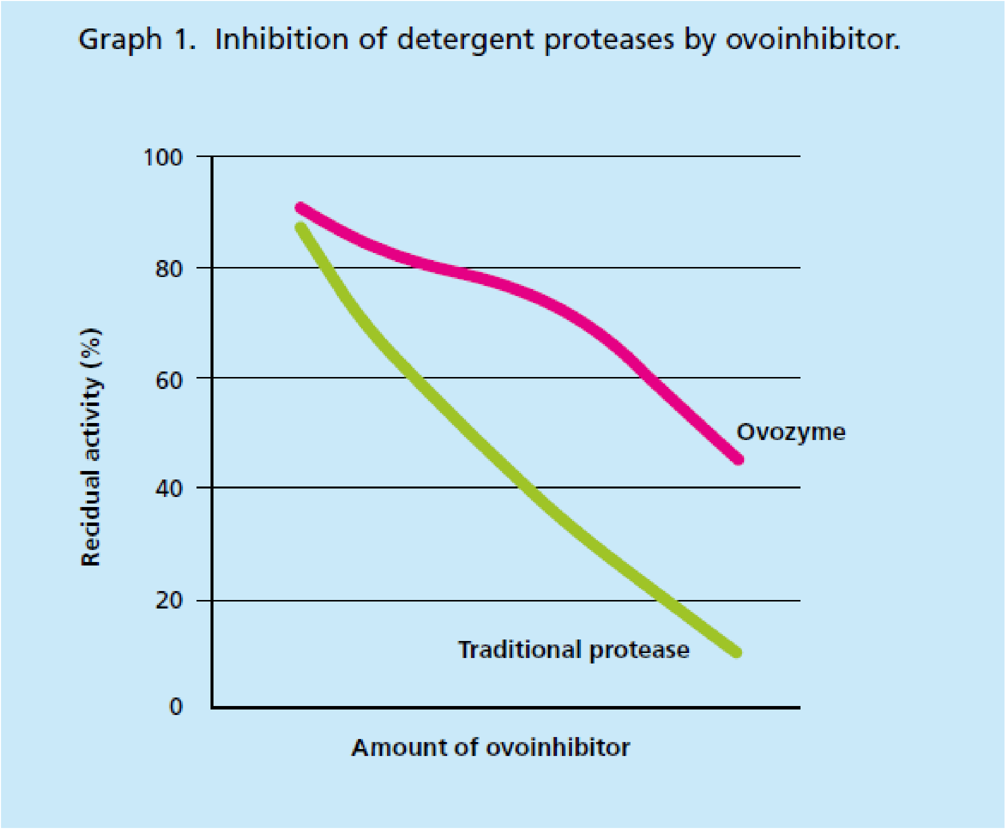
Otto Rohm first patented the use of pancreatic enzymes in 1913, since then use of enzymes in detergents have Come a long way

- A better cleaning performance in general
- Rejuvenation of cotton fabric through the action of cellulases on fibers
- Reduced energy consumption by enabling lower washing temperatures
- Reduced water consumption through more effective soil release
- Minimal environmental impact since they are readily biodegradable
- Environmentally friendlier wash water effluents (in particular, phosphate-free and less alkaline)

- Proteases
- Lactases
- Maltases
- Lipases
- Alpha-amylase
- Cellulases

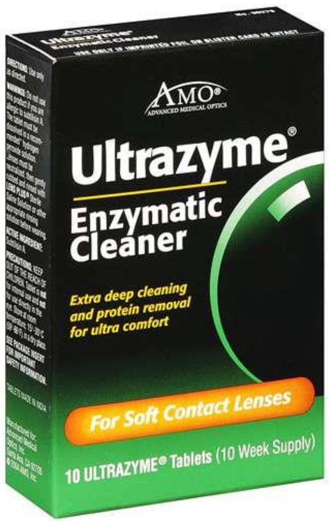
The most widely used detergent enzymes are hydrolases, which remove soils consisting of proteins, lipids, and polysaccharides.

Ingredients	Example	Approximate Composition (%)
Builders	Sodium tripolyphosphate, nitrilotriacetic acid, sodium citrate, EDTA, Polycarboxylates	38
Surfactants	Sodium alkane sulphonate, alkyl sulphate	25
Bleaching agents	Sodium percarbonate, hydrogen peroxide, sodium perborate tetrahydrate, and chlorine	25
Antiredeposition agents	Sodium carboxymethyl cellulose/sodium polyacrylate/ polyethylene glycol	2
Foam regulators/soap	Soap (sodium alkane carboxylates)	3
Water softeners	Sodium sulphate	2.5
Binder /loosens dirt	Sodium metasilicate	1
Enzyme	Protease, lipase, amylase, cellulase	1
Optical brighteners	Triazine-stilbenes, biphenyl-stilbenes, coumarins, imidazolines, diazoles, triazoles	0.5
Solvents	Alcohol, acetone	Trace
Alkalis	Sodium hydroxide, sodium carbonate	Trace
Perfumes	Citronella, lavender oil, vanilla	Trace
Fabric softeners	Imidazolinium salts	Trace

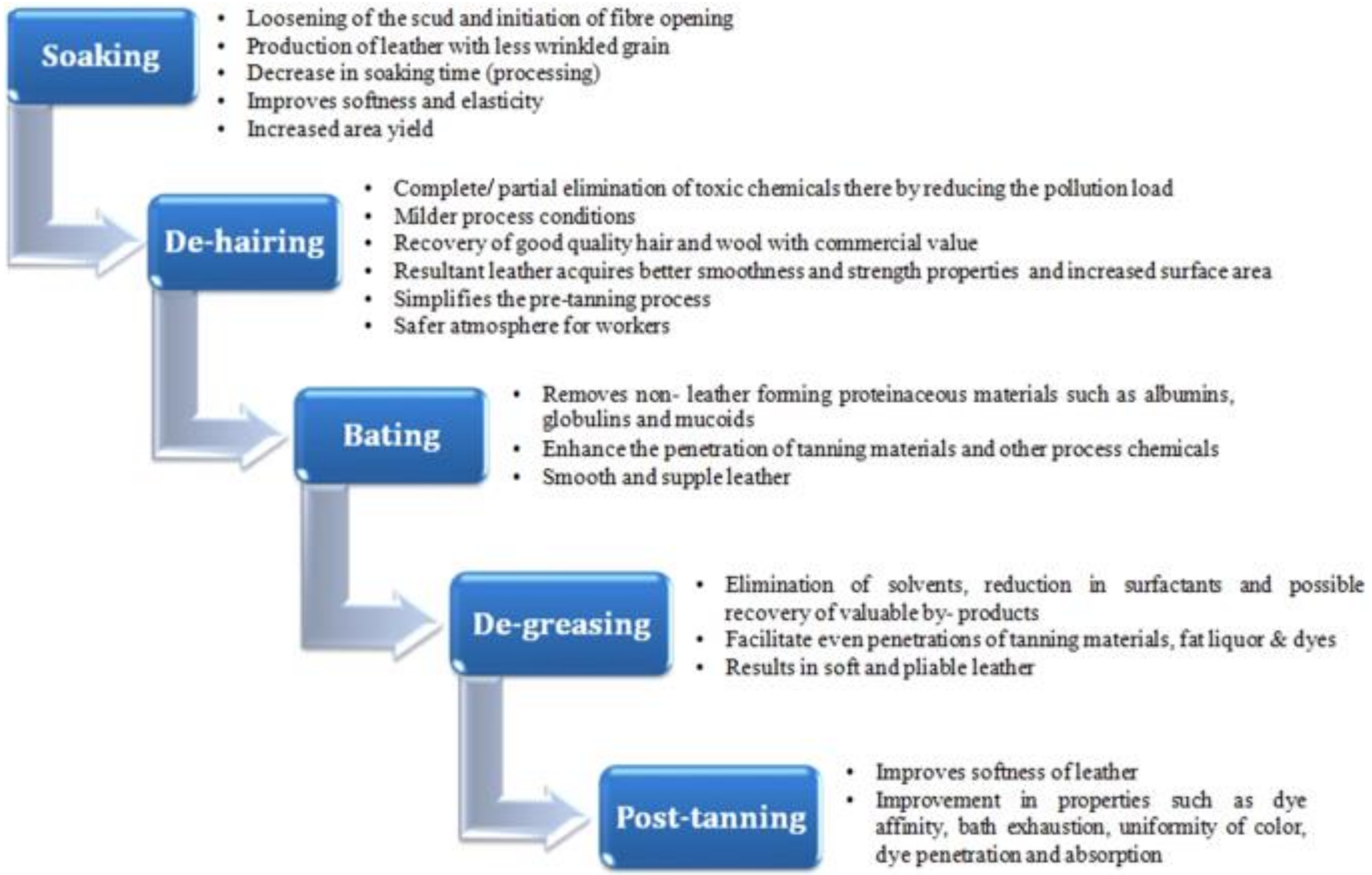


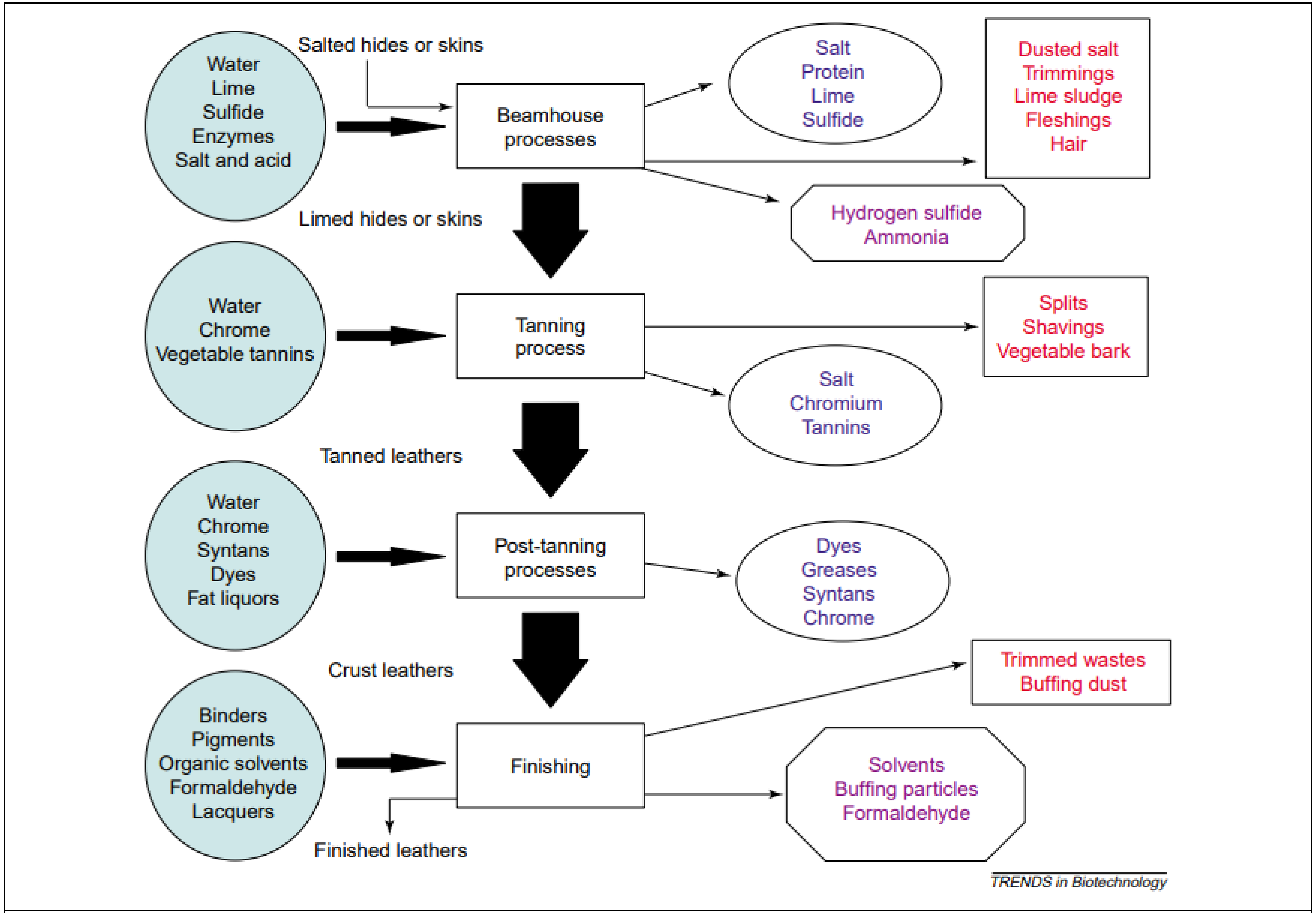
Microbial Enzymes in Detergents: A Review Sumeyra GÜRKÖK - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/COMPOSITION-OF-AN-ENZYME-DETERGENT_tbl1_337796251 [accessed 10 Jan, 2023]

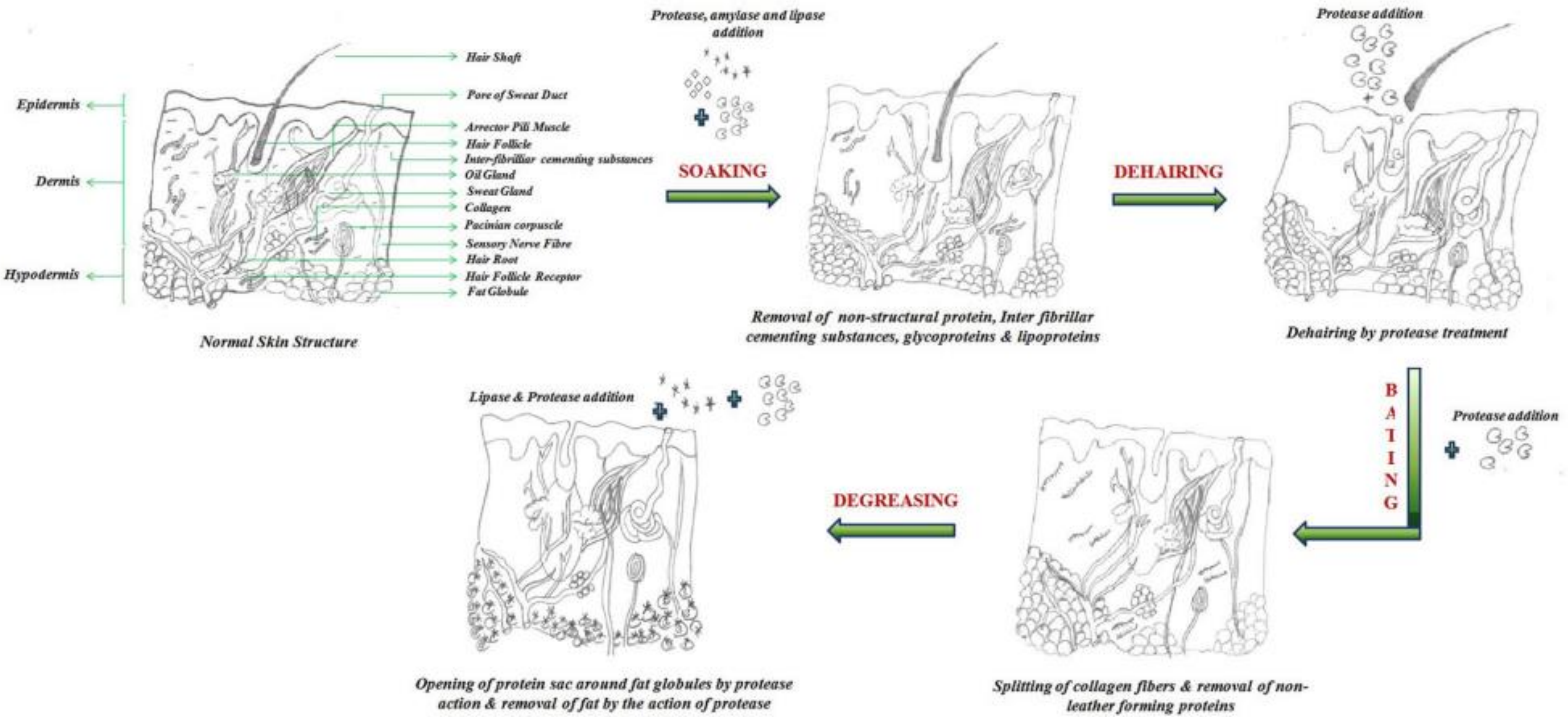
•**Papaya** contains an enzyme, papain, which is a mild whitening agent and is used in toothpastes to remove enamel stains.



Enzymes in leather industry

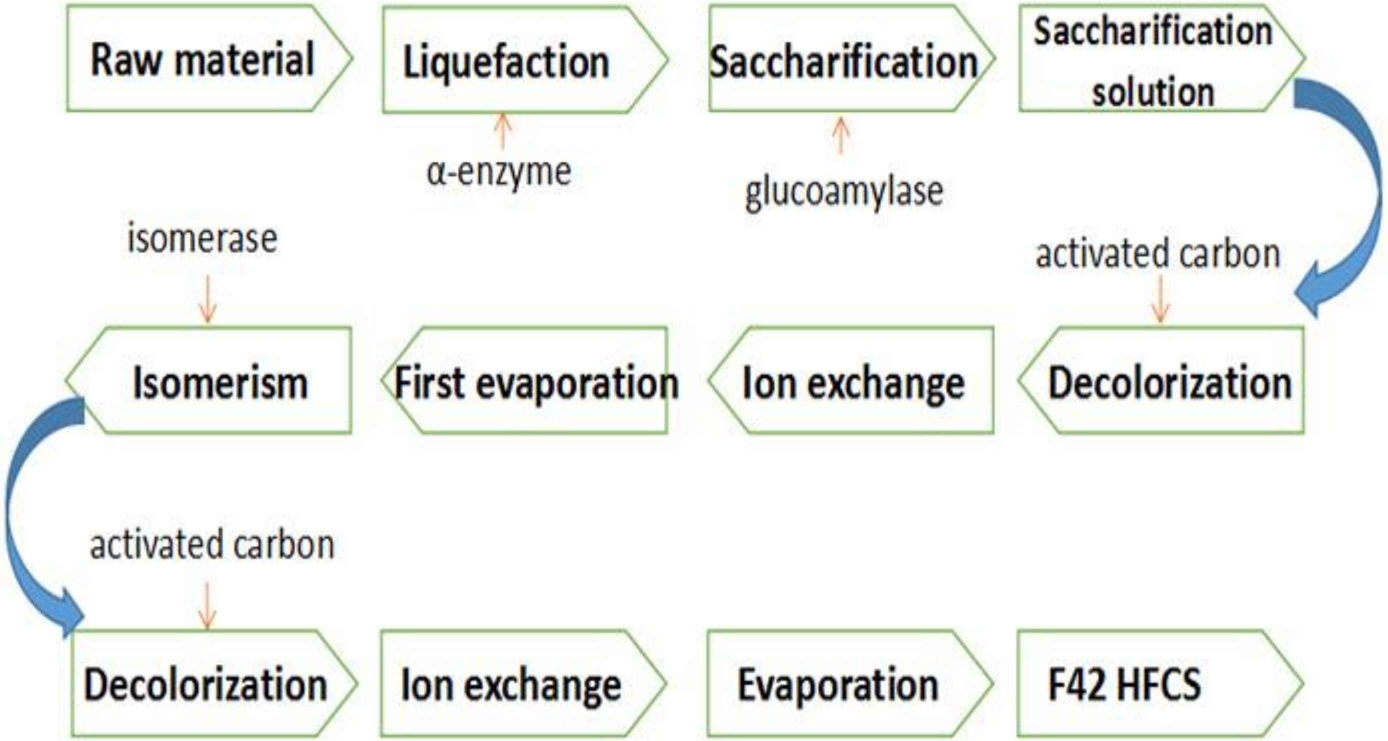



Salted hides or skins
Water
Lime
Sulfide
Enzymes
Salt and acid
Beamhouse processes
Salt
Protein
Lime
Sulfide
Dusted salt
Trimmings
Lime sludge
Fleshings
Hair
Hydrogen sulfide
Ammonia
Limed hides or skins
Water
Chrome
Vegetable tannins
Tanning process
Splits
Shavings
Vegetable bark
Salt
Chromium
Tannins
Tanned leathers
Water
Chrome
Syntans
Dyes
Fat liquors
Post-tanning processes
Dyes
Greases
Syntans
Chrome
Crust leathers
Trimmed wastes
Buffing dust
Binders
Pigments
Organic solvents
Formaldehyde
Lacquers
Finishing
Solvents
Buffing particles
Formaldehyde
Finished leathers
TRENDS in Biotechnology



Hair Shaft
Pore of Sweat Duct
Epidermis
Arrector Pili Muscle
Hair Follicle
Inter-fibrilliar cementing substances
Dermis
Oil Gland
Sweat Gland
Collagen
Pacinian corpuscle
Sensory Nerve Fibre
Hair Root
Hypodermis
Hair Follicle Receptor
Fat Globule
Normal Skin Structure
Protease, amylase and lipase addition
SOAKING
Removal of non-structural protein, Inter fibrillar cementing substances, glycoproteins & lipoproteins
DEHAIRING
Protease addition
Dehairing by protease treatment
BATING
Protease addition
Splitting of collagen fibers & removal of non-leather forming proteins
DEGREASING
Lipase & Protease addition
Opening of protein sac around fat globules by protease action & removal of fat by the action of protease

Enzymes in food processing!



Thank you!