Biotechnology Today

A Day Filled with Biotechnology

Tea Bags –
Polylactic Acid [1]

Filter Paper –
Enzyme Bleaching (Gentle Power Bleach™) [2]

Milk –
Lactase Enzyme [3]

Cereal –
GMO Corn [4]

Oil –
GMO Canola [5]

Vitamins B12, C [6]

Bread –
Enzymes (lipase, α-amylase…) [7]

A Day Filled with Biotechnology

Shirt –
GMO Cotton [4]
Jeans – Cellulase Enzyme [8]

Leather Shoes –
Enzymes [9]

Copper –
Acidophilic Microbes [10]

Acrylates –
Research in Progress

Fuel –
Ethanol

Ham, Cheese –
Proteases [11], Nisin, Chymosin [12]

Diet Drinks –
Citric Acid, Aspartame [13]

A Day Filled with Biotechnology

Vaccines –
[14]

Heartworm prevention –
Ivermectin

Insulin –
[15]

Spandex/Lycra clothes –
1,4-butanediol [16]

Detergents –
Thermo/Alkalotolerant Enzymes [17]

Beer –
Amylase, acetolactate decarboxylase, etc. [18]

Pillow –
Polylactic Acid

Agriculture

Environment

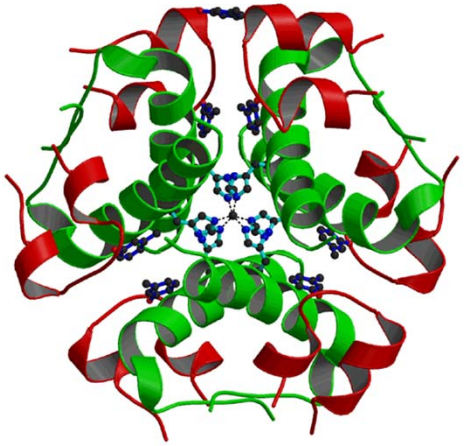
Biotechnology impacts all aspects of life!

Health

Industrial Products

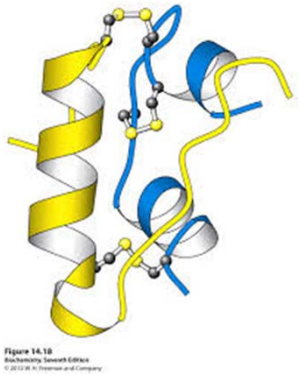
Energy

Insulin Analogs



Hexamer ←→ Monomer

STABLE FAST-ACTING

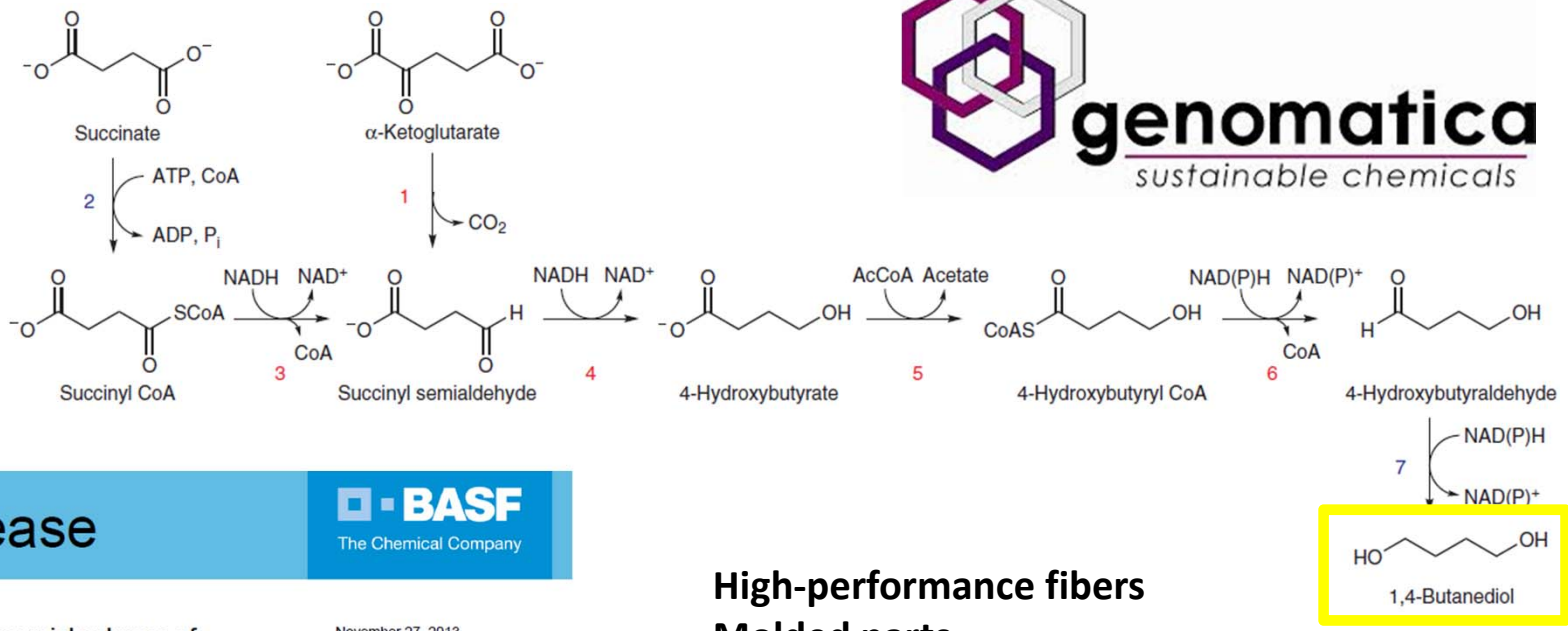


B28 Pro → Lys
B29 Lys→ Pro
(Humalog, Eli Lilly)

B3 Asn → Lys
B29 Lys →Glu
(Sanofi-Aventis, "Apidra")

B28 Pro → Asp
(Novolog/NovoRapid, Novo Nordisk)

1,4-Butanediol



genomatica
sustainable chemicals

News Release

BASF
The Chemical Company

BASF produces first commercial volumes of butanediol from renewable raw material

November 27, 2013
P538/13e
Klaus-Peter Rieser
Phone: +49 621 60-95138
Klaus-peter.rieser@basf.com

BASF has produced its first commercial volumes of 1,4-butanediol (BDO) from renewable raw material, and is offering this product to customers for testing and commercial use. The production process relies on a patented fermentation technology from Genomatica, based in California. The fermentation process uses dextrose as a renewable feedstock. The quality of BDO based on renewable raw material is comparable to petrochemical-based BDO. BASF plans to expand its portfolio with selected BDO derivatives based on renewable feedstock, including Polytetrahydrofuran (PolyTHF®).

High-performance fibers
Molded parts
Electric junction boxes
Non-woven textiles
Food packaging
Outdoor apparel and shoes

[19] Yim et al., 2011

References

[1] Tea bags made of PLA: http://teabagfilter.com/products/mesh_filter/soilon.html

[2] Use of Enzymes in textile processing: www.novozymes.com/en/sustainability/Published-LCA-studies/Documents/Enzyme biotechnology for sustainable textiles.pdf

[3] According to U.S. NIH, 65% of humans are at least partly lactose intolerant. See: ghr.nlm.nih.gov/condition/lactose-intolerance

[4] In U.S. in 2014, 93% of 91.6 million acres corn planted is GMO, 96% of 11.4 million acres cotton is GMO, 94% of 94.8 million acres soybean planted is GMO.
See: http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx

[5] GMO canola oil: http://www.canolacouncil.org/oil-and-meal/canola-oil/canola-the-myths-debunked/

[6] Article about Vitamin C production:
http://www.northsearegion.eu/files/repository/20131027214538_UK-Enclosures30.pdf

[7] Summary of use of enzymes in bread making: http://www.im-biotech.com/enzymes/baking/

[8] Stone washing jeans on enzymes use in textile industry: http://www.textileworld.com/Issues/2006/May-June/Dyeing_Printing_and_Finishing/White_Biotechnology_And_Modern_Textile_Processing

[9] Summary of use of enzymes in leather industry: http://www.im-biotech.com/enzymes/leather/

[10] Description of "biomining": http://www.siemens.com/innovation/apps/pof_microsite/_pof-spring-2013/_html_en/biomining.html

[11] Proteases are used in the production of ham and sausage to make meat tender and help separate meat from bone. See: http://www.gmo-compass.org/eng/grocery_shopping/processed_foods/32.genetic_engineering_meats_sausage.html

References

[12] Demand for cheese cannot be met with traditional rennet, which is derived from calf stomachs (i.e., and calves are slaughtered). Between 80-90% of cheese manufactured in US is produced using gene technology. See: http://www.gmo-compass.org/eng/database/enzymes/83.chymosin.html

[13] Aspartame is the methyl ester of the dipeptide phenyalanine-aspartic acid. The phenylalanine is produced using recombinant microbes. For example, see, US Patent 5,304,475: http://www.google.com/patents/US5304475 The aspartic acid is made by an enzymatic process from fumarate. The enzyme aspartase is recombinant. See: http://www.google.com/patents/US6150142

[14] Hepatitis B vaccine is an example of a recombinant DNA vaccine: http://www.who.int/biologicals/vaccines/Hepatitis_B/en/
A recombinant rabies vaccine V-RG (Tradename Raboral) has been used very successfully to control rabies in wildlife: www.raboral.com/about-rabies/Pages/raboral-v-rg.aspx

[15] A simple set of slides about insulin production: www.dnalc.org/view/15928-How-insulin-is-made-using-bacteria.html

[16] 2013 brought the successful commercialization of biological-derived 1,4-butanediol, a precursor to tetrahydrofuran used in the synthesis of Spandex. 80% of the clothes sold in the U.S. is said to contain spandex. See: www.genomatica.com/news/press-releases/successful-commercial-production-of-5-million-pounds-of-bdo/

[17] A few detergents that use enzymes: http://www.livestrong.com/article/144673-laundry-detergents-that-use-enzymes/

[18] Many different enzymes can be used in the beer making process. Most of them break down the malt, the adjuncts or unwanted by-products. See: http://www.im-biotech.com/enzymes/brewing/