Key role of enzymes for the production of pineapple leaf fibers (PALF)

R. A. Carletto[*], D.O. Sanchez Ramirez, A. Varesano, C. Vineis and R. Steffenino
Institute for Macromolecular Studies, National Research Council of Italy (CNR-ISMAC), C.so Giuseppe Pella 16, 13900, Biella, Italy
**R.A. Carletto, e-mail: r.carletto@bi.ismac.cnr.it*

ABSTRACT:

The general definition of sustainable economy is the ability of an economy to maintain defined levels of economic production indefinitely. This theme is closely linked to the introduction of environmental friendly processes, to the study of new materials obtainable from renewable sources and to the exploitation and minimization of by-products and wastes from industrial processes. The biorefinery concept match all these aspects: in a biorefinery biomass conversion processes are integrated and value-added chemicals, new materials, fuels, power and heat can be obtained ina sustainable way with environmental friendly processes. For this purpose, the employment of enzymes play a key role in biorefineries because they constitute an important alternative to the traditional chemical compounds and processes that cause environmental impact.

An interesting example is the case of Thailand, where agriculture and textile industry are working together to exploit the resources obtainable from pineapple cultivation. Thailandproduces over 2.2 million t/y of pineapple fruits; a new business connected to this cultivation is developing from the extraction of textile fibers from pineapple plantsleaves. The resulting fibersare silky, fine and haveinteresting textile properties.They can be blend with jute, cotton, ramie and some other synthetic fibres: so they can capture an important position among natural fibers as potential commercial grade textile fibers.

Pineapple leaf fibers (PALF) are obtained from the leaves of the plant *AnanasComosus*, which belongs to the *Bromeliaceae* family, these leaves contain fibers (2.5 ÷ 3.5 %), pentosans (17.8 %), lignin (4.2 ÷ 12 %), fat and wax (3.3 %) and pectins (1.1 %). To obtain PALF, other materials than fibers constitutes impurities that must be removed, in particular lignin that act as a glue for the fibrillar structure of the fibers, is responsible of the non-wettability and consequently of the non-dyeing of the fibers.
In order to remove all these impuritiespretreatments are necessary. Conventional retting is enough to remove most of them exceptinglignin that requires specific treatments. To this purpose, the employment of alkali treatment with soda could be set up as an effective solution but under the environmental point of view, it present some issues related to the resulting wastewater disposal. An interesting alternative to alkali treatment could be represented by the employment of ligninolytic enzymes.

These enzymes belong to the family of peroxidases and laccases that are naturally secreted by white-rot ligninolytic fungi as *Phanerochaetechrysosporium*, or can be produced by engineered microorganisms, as recombinant *Escherichia coli*.Furthermore as demonstrated in literature, the sustainable production of these enzymes is possible employing agroindustrialby products and wastes, in order to further contribute minimize the impact of these production activities.
Considering all these aspects, there is a need to develop an effective technology for pretreatment and extraction of pineapple leaf fibers, which is profitable and easy to use by the pineapple growers, because it is still a handmade and quite inexpert process and it needs to be industrialized, in order to reach a good and economical profitable yield.

KEYWORDS:
Ligninase; PALF; agroindustrial wastes; white-rot fungi; new plant fibers; biorefinery.