WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL RESEARCH

Review Article

2024
Volume: 01
Issue: 02
Page: 17-24

A REVIEW ON XYLANASE ENZYME

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Received: 21 October 2024 **Revised: 11 November 2024** **Accepted: 01 December 2024**

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ABSTRACT

Xylanase is the important component of hemicellulose, the second largest natural polymer on earth. There are four main classes of xylanases are arabinoxylans, glucuronoxylans, glucurono arabinoxylans and galacto glucurono arabinoxylans. The side chains of each xylan are exist supervise for the hemicellulose and therefore, influencing the mode and extent of enzymatic cleavage. Xylanases, as glycoside hydrolase members, they are able to gives rise to the hydrolysis of xylan, by breaking the β-1,4-glycoside linkages, in order to produce simpler compounds such as xylose. Many of the degrading microorganisms can generate xylanases such as fungi (Aspergillus spp., Trichoderma spp.), bacteria (Bacillus sppsolubility, physical conformation and reactivity of the xylan molecule with other components of.,. Worldwide, the market of xylanases has enlarge rapidly because of its potential in Streptomyces spp.), yeast (Cryptococcus spp.), marine algae etc. Based on their availability, microbial xylanases have dissimilar characteristics, that makes them useful for an application or another industrial use, especially in the biotechnological applications.

KEYWORDS: Xylan, xylanases, bacteria, fungi, Industrial Production.

INTRODUCTION

Xylanases and the microorganisms that them are currently used in the management of waste, to prostitute xylan to sustainable energy. The enzymatic hydrolysis of xylan, which is the second most large natural polysaccharide, is one of the most important industrial applications of this polysaccharide. The primary chain of xylan is composed of β-xylopyranose residues, and its complete hydrolysis requires the action of several enzymes, including endo-1,4-β-D- xylanase , which is crucial for xylan depolymerization. Due to the diversity in the chemical structures of xylans derived from the cell walls of wood, cereal or other plant materials chemicals, into their use in food, agro-fiber, and the paper and pulp industries, where the enzymes help to decrease their environmental impact. Oligosaccharides produced by the action of xylanases are further used as functional food additives with beneficial properties.

To meet the needs of industry, more regard has been focused on the enzyme stability under different processing conditions, such as pH, temperature and inhibitory irons, in addition to its ability to hydrolyze soluble or insoluble xylans. Although more wild-type xylanases contain certain desired characteristics, such as thermostability, pH stability or more activity, no individual xylanase is apt of meeting all of the requirements of the feed and food industries. Moreover, as industrial applications require inexpensive enzymes, the elevation of expression levels and the efficient discharge of xylanases are crucial to ensure the viability of the process; therefore, genetic engineering and r- DNA technology have an important role in the large-scale expression of xylanases in homologous or heterologous protein-expression hosts. Considering the future possibilities of xylanases in biotechnological applications, the goal of the review chapter is to present an overview of xylanase production via fermentation and to report some of the characteristics of these enzymes and their primary basis, xylan. Moreover, this review will discuss the fermentation processes as well as the genetic techniques applied to enhance xylanase yields.

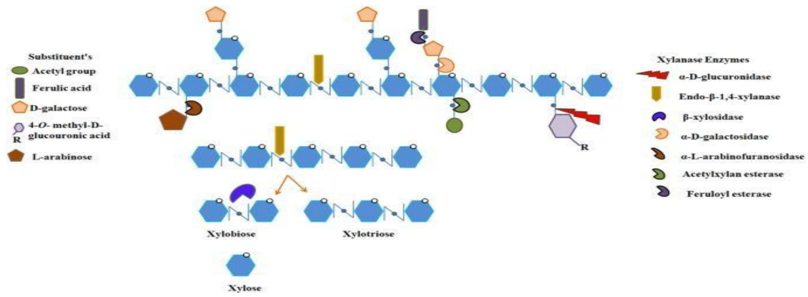

Fig. 01: Structure of xylan showing bonds.

Xylanase production depends on media formation and involving substrate. Filamentous fungi produce more Xylanase than the yeast and bacteria but fungal Xylanases are generally associated with cellulose activity. Trichoderma & Aspergillus species produces xylanase by using pure Xylanas substrate for enzyme production. These strains ,which may be due to the presence of trace s of hemicelluloses in the cellulosic substrate,The process that controls the extra cellular enzyme-Production according to the carbon sources of medium are affected by the availability of precursors for protein synthesis. Bottom nitrogen/carbon ratio in the medium may be one of the strategies for cellulose free xylanase production ,cellulosic substrates in the medium were also found to be necessary for the extreme xylanase production by Clostridium scleroarium. Thermomonosporacurvata and Neurospore crassa. Agro waste substrates like corncob, ricestraw, wheat straw, wheat bran corn stalk and bagasse can be used as a substrate for xylanase production by certain micro organisms like Aspergillus awanian. Penicilluim purpuro genum and alkaliphilic thermophilic Bacillussp. Xylanase activity is found to be higher in fungal system with extreme activity of 3350IU/ml in Trichodermareesi than Bacterial systems. Maximum activity in solid state formation was achieved from the fungus Schizophyllumcommun. Trichodermahamatum with activity of 7000IU/g have been reported using wheatstraw as a substrate for Xylanse production. Cellulose free Xylanase producer has been resulted in Bacillus spand fungi. Fungi commonly need acidic pH but Actino mycetesand bacteria need neutral pH optima for Xylanase production.

Source for xylanase production

The xylanase is popular in nature and its presence is observed diversely in a wide range of living organisms, such as marine, terrestrial and rumen bacteria, hermophilic and mesophilic fungi, protozoa, crustaceans, snails, insects, algae, plants and seeds. Bacteria and fungus are usually used for industrial production of xylanase. Several microbial sources of xylanase are classified.

Bacterial sources of xylanase

Among bacteria, *Bacillus* species have been reported widely as the extensively potent xylanolytic enzyme producers such as *Bacillus* sp., *B. halodurans*, *B. pumilus*, *B. subtilis*, *B. amyloliquefaciens*, *B. circulans*, and *B.*. Xylanase with increased temperature stability, acid stability, and cold adaptability have been isolated and purified from a wide range of bacteria found in extreme environment. Thermo tolerant xylanase active at a high temperature of 60–70 °C has been resulted from *Bacillus* spp. *Bacillus Halodurans* TSEV1, *Clostridium thermocellum*, *Rhodothermus marinus*, *Streptomyces*, *Thermotoga thermarum*. Psychrophilic xylanases are not very common but seen to be isolated from several bacteria such as *Clostridium* sp. PXLY1, *Flavobacterium* sp. MSY-2 and *Flavobacterium frigidarium* *Pseudoalteromonas haloplanktis* TAH3A.

Mode of action of xylanases grouped under various GH families

There is the difference in structure, physicochemical properties, substrate specificities and mode of action of members of GH families 5, 7, 8, 10, 11 and 43. The hydrolysis of xylan by xylanase may occur by two different mechanisms, i.e., retention or inversion.

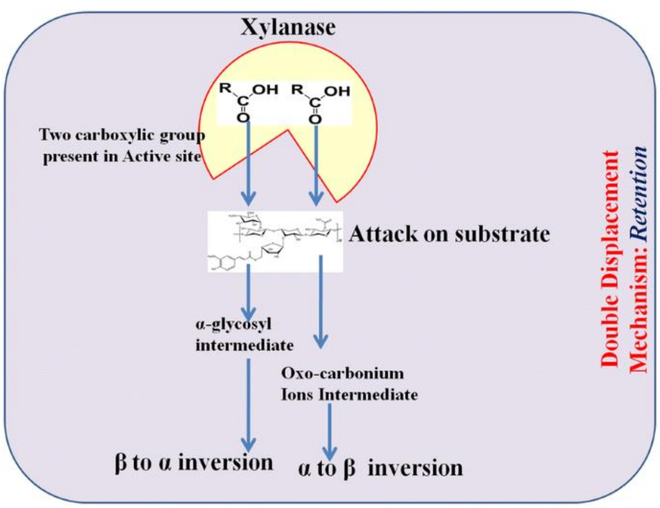

Fig 02: Mode of action of xylanase.

Applications of Xylanase Enzyme

The market of xylanase has increased considerably worldwide, over the past few years. Microbial xylanases have attracted a great deal of regard, because of their biotechnological potential in different industrial processes such as food, feed , pulp and paper industry. Also, they have shown an immense potential for increasing the production of several useful products in a most economical way. The main creadibles are the production of SCPs, enzymes, liquid or gaseous fuels and solvents and sugar syrups, which can be used such as feed stock for other microbiological procedures. Consequently, xylanases are considered as "one of the most industrially important enzymes".

Pulp and paper industry

Chemical bleaching in the pulp and paper industry is used to enhance the paper brightness. Unfortunately, this causes serious damages of the cellulose compounds and reduce the yield and viscosity of the pulp. The level of viscosity is related to the degree of cellulose polymerization and to the paper strength so decreasing viscosity is not sensible . The participation of xylanase in the biobleaching of pulp. The researchers, focused on using xylanase mainly for diminishing the chemical consumption, few studies being conducted on the effects of this enzyme on the yield and viscosity of the pulp .With this technique, the pulp is usually deal with xylanase before chemical bleaching .The reprecipitated xylan is decomposed in the presence of xylanase, this make possible pulp bleaching and decreasing the chemical consumption. By this means, this technique decrease the toxic compounds produced into the environment.

Animal feeding

Including xylanases into a rye-based diet of broiler chickens developed in reduced intestinal viscosity, thus upgrading both the weight gain of chicks and their feed conversion production Xylanases, used as pretreatment of forage crops, enhance the nutritional properties of agriculture fodder and grain feed, thus increasing the digestibility of reflective feeds and facilitating integration. However, the complete removal of xylan is not used, because hemicelluloses are important compounds of diet and their removal may enhance bowel diseases.

Food industry

Xylanases ameliorate the quality of bread, by improving the specific bread volume. This is further increased when amylase is used in composition with xylanase During the bread-baking process, they delay crumb formation, entering the dough to grow. Another use of xylanases is as dough rye baking, where the insertion of xylanase makes the doughs soft and slack strengthners, because they provide excellent wilingness to the dough towards dissimilarity in processing parameters and in flour quality. Also, enormous number of arabinoxylo-oligosaccharides in bread would be favourable to health.

CONCLUSIONS

For the disintegration of xylan, the main compound of he,4-endoxylanase, β- xylosidase, αglucuronidase, α-L-arabinofuranosidase micellulose, is needed for the combined action of xylanolytic enzymes such as: β-1, acetyl xylan esterase and phenolic acid esterase. Based on the source, majorly bacteria or fungi, xylanases have more characteristics which makes them useful for an execution or another. Xylanases present enormous potential in different industrial areas or research fields such as: pulp and paper, animal feed, food industry, hemicellulosic wastes, biofuels, fabric bioprocessing, treatment of plant cells,liquid refreshments and food industry.

ACKNOWLEDGEMENT

The authors express their sincere thanks to the management, Mother Teresa Pharmacy College, Sathupally, Telangana for providing the necessary facilities to carry out the review article.

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