

## **A REVIEW ON PECTOLYTIC ENZYMES AND THEIR INDUSTRIAL APPLICATIONS**

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### **Abstract**

Recently, pectin has introduced as one of the food additives. The presence of pectin naturally or intentionally is pronounced regarding to know its technical characteristics depending on the application targeted. One of the industrially processor agents of pectin is pectic enzymes. These enzymes are not only effects on food industries but also can be used technically in other industries such as textile and so on. The aim of this overview is to study of pectin structure and different pectolytic enzymes from the viewpoint of both study and commercializing.

**Keywords:** pectin, pectolytic enzymes, pectin methyl esterase.

### **INTRODUCTION**

Primarily, food science is the combination of practice and approaches of converting raw material to fitted food and beverage for human consumption.<sup>1,2</sup>

With respect to the amount of practical processing of raw material, produced food classified into 3 groups as minimally processed foods, processed food ingredients and highly processed foods<sup>3</sup>. The recognition of a technique which is practiced in production of food depends on the special chemical or biological agents, so called name Enzymes today. Perhaps can be mentioned that bread and cheese making are first detected and introduced microbial products dating back to 6000BC.<sup>3,4</sup>

In the 19th century, using of Rennet and bacterial amylase introduced. Even the enzyme concepts, both scientific and technical, has been a part of daily routine, it is still a deep question in mind regarding a clear picture of all chemical mechanism toward all these reactions. Having large demand of enzyme applications in industries led to continuously trend for a rapid commercialization of enzyme usage in food industry as well. Currently a 7 billion dollars' market of enzyme applications make it ascertain a real business.<sup>5,6</sup> Mainly enzyme usages are in detergent, textile, paper industry and a part also dedicates to food and feed industry.<sup>7,8</sup> Pectinases are the first domestically enzymes used in fruit juices<sup>3</sup>. They helped juice to remain stable and clear. Reduction of viscosity, enhanced yield via more structure disrupting and higher quality puree are reasons to add pectinase to fruit juices.

Recently, enzyme technology makes it possible to develop manufacturing of high value added products in order to fulfil technical and market requirements of industries such as textile, pharmacy and food. A driving force in outreach

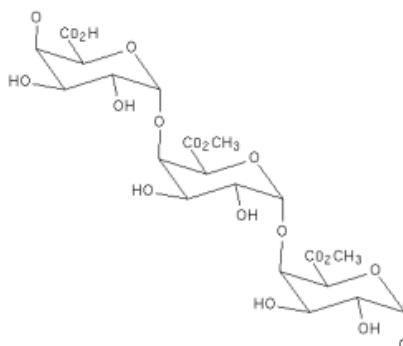
of enzyme technology will be focused on developing of innovative techniques to meet prerequisites and requirements of industries, better products and more yield from biomass material.

The main subject in developing technology of Enzymes is to create a sustainable system to meet both economic and environment issues from the viewpoints of diminishing the use of raw sources and in the same time increase the waste reusing and recycling per kilogram. Enzymes, formerly named bio catalysts, act selectively in catalyzing chemical and biochemical reactions in all live organs.<sup>9</sup> Growing the depth of our knowledge about Enzymes, in line with their bio productions in state optimizing and modifying of enzymes in order to solve analytical problems.

### **Pectin; structure and source**

Pectin is composed of polysaccharide units, mainly of D-galacturonic acid (GalA) units<sup>10</sup>, joined in chains by means of  $\alpha$ -(1-4) glycosidic linkage, by which one third of cell wall, mostly lamella, is created gradually decreases toward membrane.<sup>11</sup> The monomers of galacturonic acid are esterified by methyl groups or galactans, arabinogalactans, arabinans, and rhamnogalacturonans.<sup>12</sup>

Since pectin has the potential of being developed as gelling agent, its size and degree of esterification are two critical parameters to judge its ability to create a set gel. On the other hand, presence a large amount of it shall not certainly be an indicate of a commercial source of pectin.<sup>13</sup>



**Figure 1. pectin structure (<http://www.cybercolloids.net/>)**

### **Pectic enzymes**

The so-called pectic Enzymes refer to those with ability of breaking down the uniformity of cell wall.<sup>12</sup> The market of enzymes has allocated 25% to pectic enzymes.<sup>14</sup> Three varieties of molds including *Coniothyrium diplodiella*, *Sclerotinia libertiana*, *Penicillium spp.*, and *Rhizopus spp* along with *Aspergillus* (*Aspergillus Niger* mainly uses in beverage industry) are producers of pectic enzymes.<sup>12,15,16</sup>

Currently, pectic materials classify into 4 groups; 1) protopectin, 2) pectic acid plus galacturonans, 3) pectinic acid composed of polygalacturonan chain with various amounts of methoxyl groups (0–75%) & 4) pectin.<sup>14,16,17</sup>

With respect to the pectin compounds, pectin enzymes are categorizing into 3 groups as below:

- Protopectinases which catalyze breakdown of protopectin to highly soluble polymer
- Pectinesterases which remove methoxy esters (de-esterification)
- depolymerases which catalyze the hydrolytic cleavage of the  $\alpha$ -1,4-glycosidic bonds in the galacturonic acid.<sup>14,15</sup>

First time, pectic enzymes used in fruit juice and wine.<sup>16</sup> the same employed enzyme in scintillating juice is used to enhance the yield and clarification of juice,<sup>15,16</sup> in addition the reduction of filtration time.<sup>12</sup>

Since being cloudy is a consumer acceptance factor of juices, pectic enzymes play a key role in this regards owing to stabilizing the cloud of Orange, lemon, mango, apricot, guava, papaya, pineapple, and banana juices.<sup>16</sup>

Enzymatic treatment of orange juice caused to stabilize cloudiness with no breakdown of insoluble pectin In maceration process, pectic enzymes are used after a mechanical treatment.<sup>16</sup>

Other commercial targets of pectic enzymes are removing sizing agent from cotton, degumming of fibers, removing waste water and other by-products from vegetable processing factories<sup>18,19</sup> Furthermore, in producing animal feed, paper and citrus oil, pectic enzymes are used.<sup>20</sup>

**Table 1 summarizes some recent studies on the pectic enzymes and their applications.**

Industrial branch	Application case	Reference
1	clarification of fruit juices	21
2	fruit purees, deskinning of orange segments,	22
3	wine clarification	22
4	improve press ability of pulp and disintegrate jelly	23
5	improved chromaticity and stability of wines	24
6	pectinases are utilized to depolymerize polymers of galacturonic acids that subsequently lower the ca-tionic demand of pectin solutions	25
7	biobleaching	26
8	Peroxide bleaching of thermo-mechanical pulp produces alkaline pectinaceous filtrate,	27
9	paper making industries	28
10	pectinase treatment has resulted in good quality handmade paper from the treated banana fibers	29

## Conclusion

Despite the wide range of today applications and targets of using pectic enzymes are in fact, but still innovative methods can be introducing in order to have and create the new opportunities of introducing these technical enzymes

to industries. In addition, finding those genes interfering the coding of enzymes, molecular biology techniques will give a better perspective of the biochemical reactions of pectolytic enzymes and thus better engineering aids in industries.

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