Pectin bioactivity

Identification

Key words
Pectin, dietary fibre, immunomodulation, anti-cancer agent, bio-based products, detoxification

Latest version
2013/04/08

Completed by
KU Leuven LFT

How does it work?

Primary objective
Describing the health promoting bioactive properties of pectin and highlighting associated structure – function (bioactivity) relations.

Working principle
Pectin is a complex polysaccharide in the cell wall of plants that contains linear as well as branched parts. During food processing and digestion, pectin can undergo several structural changes. The structural properties of pectin are key factors in controlling the health-promoting properties of these components. Besides the health benefits of pectin as dietary fibre, pectin has the potential to work against inflammation and cancer and it can bind heavy metals.

As dietary fibre, pectin is reported to prevent cardiovascular diseases by lowering blood cholesterol levels. Furthermore, pectin can limit fat absorption in the body by inhibiting pancreatic lipase activity. Finally, small pectin fragments are reported to enhance immune functions by promoting some prebiotic activities and preventing bacterial adhesion. These health-promoting properties of pectin are mainly attributed to the linear part of the polysaccharide [1,2,3]. Pectin has the potential to work against inflammation by stimulating a series of defensive reactions of the immune system. In case of wounds and oedema, this results in an enhanced healing process. The effect of pectin on the immune system is mostly attributed to the branched regions of pectin [4]. As an anti-cancer agent, pectin can prevent or reduce tumor growth by binding to a protein involved in cancer, i.e. galectin-3. This binding inhibits the ability of galectin-3 to promote the propagation of cancer cells and to prevent cell death. This pectin bioactivity is mainly attributed to branched regions of the polysaccharide [5]. Finally, pectin has been shown to reduce blood levels of heavy metals, thus detoxifying the body. This property is ascribed to some branched regions of pectin [6]. Except for pectin’s prebiotic features, which have been evaluated in vitro, other biological properties of pectin have been assessed on animals and/or humans.

Images

Additional effects
Pectin has been used in the production of bioactive materials. The ability of pectin to form a network in the presence of Ca2+ renders it suitable for the production of apatite, the major bone mineral. Hence, pectin can be used in repairing bone defects [7]. In addition, the Ca2+-crosslinking property of pectin enables the production of materials used in tissue culture and engineering [8]. Finally, pectin can also be used for the production of controlled release matrices for colon specific drug delivery [9].

Pectin structure-bioactivity relations can facilitate strategic process design for pectin-rich materials (fruit/vegetables) in order to achieve selective in situ modification of the polysaccharide. This will enable the production of processed fruit/vegetables with specific bio-functionality.
Important process parameters
As pectin is easily reactive, all process parameters (e.g. pH, temperature, pressure, time...) must be carefully controlled in order to achieve targeted modifications.

Important product parameters
The structural features of pectin vary with the botanical source. This implies that the production of pectin with definite bioactivity and, thus, specific structural features, requires the choice of appropriate pectin sources.

What can it be used for?

Products
Commercial pectin, processed fruits and vegetables, pectin-containing foods

Operations
Thermal processing, high-pressure processing, high-pressure homogenisation and/or enzyme technology can be applied to create bioactive pectins.

Solutions for short comings
Engineering healthy and functional foods, molecular gastronomy

What can it NOT be used for?

Products
Products that do not contain plant-based ingredients

Operations
No restricted operations when dealing with pectin-containing food products

Other limitations
Some bioactive properties of pectin have not yet been evaluated on human beings. Limited knowledge on human digestion of pectin may prevent accurate interpretation/applications of in vitro studies and animal digestion studies.

Risks or hazards
Further processing of engineered foods, such as during handling by consumers (heating, microwaving), can affect the structural features of pectin, thereby altering or destroying the desired bioactivity.

Implementation

Maturity
Clinical trials have been made, e.g. [10-11].

Modularity
Not applicable – current types of food processes can deliver the required structural features for the bioactivity of pectin.

Consumer aspects
Consumers preference will be high. Food containing pectin is health-promoting.

Legal aspects
Not applicable.

Environmental aspects
Not applicable.

Facilities that might be interesting for you

Title
Auditorium IRTA
Clean room – Histocell
Video observation system for market research and product development tasks - Keki

Institute/company
IRTA
Noray
NAIK EKI
Further Information

Institutes
University of Alberta AFNS, IFR, Maastricht University Human Biology, UiO Pharmaceutical Chemistry, Heinrich-Heine-University - Institute of Pharmaceutics and Biopharmaceutics, Kyushu Institute of Technology

Companies
Nakashima medical

References