

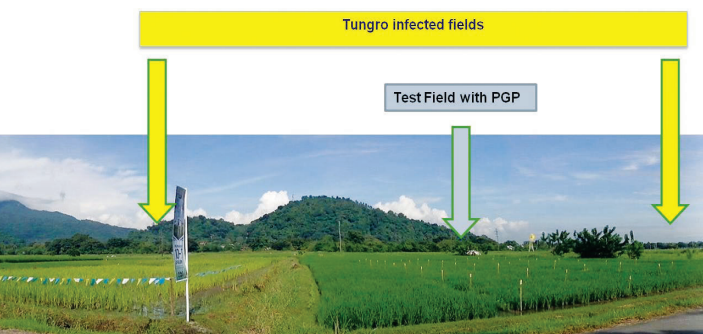
Agricultural Applications

Plant Growth Promoters

Radiation-induced degradation of natural polymers is a promising application of ionizing radiation to develop natural bioactive agents. Polysaccharides, which are degraded by radiation, yield oligosaccharides (polymers with shorter chains). These oligosaccharides had been shown to have antibiotic, antioxidant and plant-growth promoting properties.



Plant growth promoters (PGPs) were developed by DOST – Philippine Nuclear Research Institute from radiation-processed natural polymers such as seaweed (carrageenan) and chitosan (shells of shrimps). The effects of these PGPs are being tested on rice, mungbean and peanut.



Field testing on rice sprayed with PGPs showed no signs of rice tungro bacilliform virus disease infection.

Results of pot experiments showed that the PGPs from irradiated carrageenan and chitosan increased the yield of mungbean, by 310% (PGP from carrageenan) and 194% (PGP from chitosan), in an average of two seasons.

For peanuts, results showed an increase during the wet season of 346% and 270% for carrageenan and chitosan, respectively.

For mungbean, a 250% increase in yield was realized using oligocarrageenan while a 32% increase in yield was observed in oligochitosan-treated rice plants.

ADVANTAGES of Plant Growth Promoters

- Stimulates flowering
- Promotes uptake of nutrients which thereby increases the yield of crops
- Environment – friendly natural product

BENEFICIARIES

- Farmers
- Agri-based entrepreneurs
- Gardening enthusiasts
- Seaweed industry



Department of Science and Technology
PHILIPPINE NUCLEAR RESEARCH INSTITUTE

Commonwealth Avenue, Diliman, Quezon City
PNRI Trunkline: (632) 929.6010 to 19
Website: www.pnri.dost.gov.ph

Facebook: DOST - Philippine Nuclear Research Institute

Radiation-Processed
Materials from
Natural Polymers for
Agricultural, Health
and Other Applications



For more
information,
please
contact:

Lucille V. Abad, Ph.D.

Career Scientist I
Head, Chemistry Research Section
Atomic Research Division
Philippine Nuclear Research Institute
(632) 920.1655
(632) 929.6010 to 19 local 234
Email: lvabad@pnri.dost.gov.ph

Radiation-Processed Materials from Natural Polymers for Agricultural, Health and other Applications

Radiation processing is one of the applications of radiation technology which involves exposing materials, such as natural polymers, to ionizing radiation, either gamma radiation or electron beam, to impart desirable effects. It is a clean and additive-free method for preparation of value-added novel materials based on renewable, non-toxic and biodegradable natural polymers. Among naturally-occurring polymers are the cellulose in plants and tree; chitin in the shells of shrimps, crabs and other crustaceans; agar, carrageenan and alginates in seaweed.

Advantages of Radiation Processing

- ☑ SAFE
- ☑ EFFECTIVE
- ☑ A RECOGNIZED ALTERNATIVE TO CONVENTIONAL METHODS

Under adequate conditions, natural polymers either undergo degradation or crosslinking upon interaction with ionizing radiation. Degradation involves the reduction of molecular weight of polymers. Radiation cross linking is a procedure whereby molecules are linked to one another by irradiating the material with high-energy electron beams or gamma rays.

The Philippine Nuclear Research Institute (PNRI) has been conducting research and development studies on radiation processing of natural polymers (carrageenan, chitosan, cellulose) to develop these materials into useful products for health, agricultural and other applications.

Health Applications

Polyvinyl pyrrolidone carrageenan hydrogel dressing—for wounds, burns and bedsores

Through radiation processing, PNRI researchers have successfully developed a hydrogel dressing based on carrageenan and polyvinyl pyrrolidone. This dressing is intended to cover wounds, to absorb wound exudates, to protect wound against abrasion, friction and contamination. Gamma radiation was utilized for crosslinking and sterilization of this hydrogel dressing with the trademark name of Skin-Up™. The product has been awarded with a patent and is ready for commercialization.

Competitive edge of the PVP-carrageenan hydrogel:

- Abundance and availability of carrageenan as raw material
- Crosslinking and sterilization through radiation technology eliminates the use of toxic chemicals
- Cheaper than a commercial product because resources used are locally available.
- Projected price is cheaper than other commercial dressings presently available in the market



PVP-Chitosan Injectable hydrogel implant—for cure of primary vesicoureteral reflux

PNRI researchers, in collaboration with medical doctors, are developing an injectable hydrogel based on chitosan and polyvinyl pyrrolidone through radiation crosslinking. This injectable hydrogel can be used for the cure of primary vesicoureteral reflux, which is a common urologic anomaly in children associated with urinary tract infection. Preliminary results of the studies showed that the chitosan-PVP hydrogel has properties of a good tissue-augmenting implant comparable to a commercially available imported surgical implant.

Advantages of the injectable hydrogel implant:

- Cheaper than a commercial product because resources used are locally available
- Can pass through gauge
- High insoluble content
- Stable
- Biocompatible



Hemostat—material used to help arrest bleeding of ruptured blood vessels

Hemostats with different formulations and forms were prepared from chitosan, carboxymethyl cellulose, carboxymethyl carrageenan and combinations of these natural polymers and crosslinked with gamma radiation. These hemostats are tested for hemostatic efficacy. Initial tests conducted in vitro using swine blood indicated that the carboxymethyl-cellulose hemostat developed by PNRI was comparable in performance to a commercial hemostat product.