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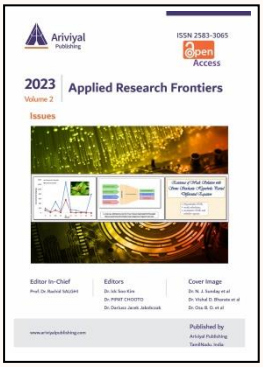

Chemical Procedure and Characterization of Radio-Chromic Dosimeters for Spectroscopic Measurements

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Abstract: Todays, the plants gel sensitive to radiation were converted to smart and reliable tools for measurement of the three-dimensional dose distribution. Three-dimensional dose distribution in radiochromic dosimeter on chemical matrix was produced in micro-scale, and then was obtained measurement after radiation with ionic beams such as gamma-ray. The main goal of this investigation is preparation and characterization of radio-chromic dosimeter with plant materials with using of microtechnology and application of ideal dosimeter in micro-scale forwarded for three-dimensional distribution of ionic beams. This ideal dosimeter is with water absorption properties, that these properties were concluded with radiologic properties. The results of these studies present, access to procedure of fabrication plants gel dosimeter in micro-scale and application as dosimeter gamma beams. The method of investigation is chemical method with applying the best ratio of Gelatin/Gene-pin, water; acid sulfuric (H_2SO_4) components and the best condition of reaction were presented for spectroscopic measurements.

Keywords: Radio-Chromic; Dosimeter; Ionic Beams; Measurements

1. Introduction

Gene pin is a hydrolytic product of Gen-opozide that find in fruit of Yes-man greenhouse plants. The compositions of these plants are in chines medicines as blue pigment in food industries in East Asian. The structure has been discovered in 1960, because these have a natural structure, and its molecules are able to decompose and have low toxicity. Recently, Gene-pins have been used as natural crosslink agent in natural applications. This material have been applied as a crosslinking agent with Gelatin, and use as bio-adhesive, space suits and substitute material, which have high potential as new crosslinking agent. The most common crosslinking agent is Glotar-Aldehide with the highest toxicity, this prevents widespread use. Debrocy and et.al, have been discovered Gene-pin structure with using Nuclear Magnetic Resonance (NMR) and chemical analysis in 1960.[1]

This has a specific molecular formula with Di-hydropyran rings. Gene-pin alone is colorless, but react with amino-acids for blue pigments formation.[2-3] Fig. 1 presents the Gene-pin structure with other characteristics.

Fruit of Yes-man plant is plant source of Gen-oposide. Fig. 2 presents a picture of Yes-man greenhouse plant. This always is green plant that grows 4-8 foot in high and wide. Its fruit has about 0.5-1 inch in long and to orange color. Yes-man fruit is as Chinese medicines in treatment of genetic and blood diseases. The main component of Yes-man plant fruit is Gen-oposide.[3-6] Fig. 3 Presents the structure of Gen-oposide.

Separation Gene-pin from Gen-oposide

Ando and et.al have separated Gene-pin from Genoposide. This method was used and cured modification on this section.[7]

Gene-pin and Bio-Materials

Recently, Gelatin is a bio-material for using in bioadhesive, space suits and alternative materials. Gelatin is a natural polymer that analyzed with living agents. This was solved in aqueous solution and lead to fast analyzing in body temperature. A method to reaction with Gelatin is for crosslink agent. Chemical crosslinking to formation bonding between amino-acids functional groups.[5,6] The reports tell a story of toxicity this method to formaldehyde formation. To this reason, Gene-pin was used as a new crosslinking agent for low toxicity.[7-9]

Gene-pin Crosslink Mechanism

The mechanism of Gene-pin crosslink with Gelatin and molecules with first type amines unwell known and under investigated. Toyama and et.al have proposed a mechanism of reaction Gene-pin with methyl-amine.[8]

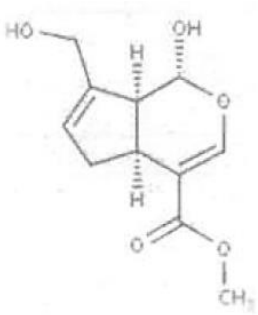

Fig. 1. The structure of Gene-pin

Fig. 2. A picture of Yes-man greenhouse plant

This investigation group have proposed that reaction path is nucleophile attack first type of amines on third carbon of Gene-pin that cased opening of the hydropyran ring. An attack has remained on aldehyde group that followed with second type of amines.[8] The mechanism of Gene-pin with methyl-amines is like the mechanism of Gene-pin and Gelatin that has first type of amines. The final step in formation cross-linked material is dimerization with radical reactions. This presents that Gene-pin can be used for internal or external molecular crosslinking formation with hetero-cyclic structures and reacted with first type of amines. Gene-pin is a natural crosslinking material that has high potential as application in bio-material reaction. Cross-linked Gene pins be useful as bio-adhesive, space suits and bone Substitutes materials. In addition to this research, the investigations on cross-linked Gene-pin to chitosan are important for drug delivery and protein. On this basis, Gene-pin is a cross-linked agent for bio-material in future.

2. Experimental Section

Gelatin (type Sigma-Alderich, grade 250, Blum 300) was solved in water and then Gene-pin was added. The mixture was stirred in hot water baths in 450°C. The solution was colored in colorless to blue color slowly and then blacked. The mixture of gelatin and Gene-pin were mixed together before sulfuric acid addition (as blending time). After sulfuric acid addition to mixture, the solution was pipetted to 1CM plastic containers and maintained in 4°C temperature for one day. The samples were irradiated in CO60 gamma source in dose over 100Gy. The irradiation was cased color changes in gel that was measured in Spectrophotometer in 600nm. The experimental method was done without blank sample and we can use replace material instead in Gene-pin, because this is very expensive and inaccessible material.

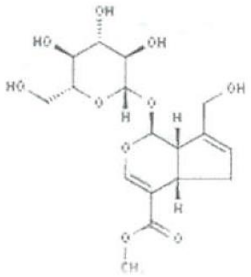

Fig. 3. The structure of Gen-oposide

3. Results and Discussions

3.1. Gel-Polymer Dosimeters

Gel-polymer dosimeters were prepared from chemical materials sensitive to radiation that polymerized on basis radiation as absorbed radiation dose. These gel dosimeters with dose distribution were demonstrated in 3-dimensional and have advantages in comparison with single and double dimensional such as film. Also, gelpolymer dosimeters have important advantages in Brocket-therapy dosimeters. The dosimeter applications are low energy X-ray, linear energy transmission and proton therapy and neutron therapy dosimeters. These dosimeters are suitable for soft fabrics radio-logically and purification depends to applications and check with different techniques. Three-dimensional distributions of gel-polymeric dosimeters were imaged with Nuclear Magnetic Resonance (NMR), Optical-CT and X-ray CT or Ultrasonic.

3.2. Gel Dosimeters (Radio-Chromic)

Gel dosimeters are able toward maintain dosimeter information in 3-dimensional that have advantages in radiotherapy applications.[10] Gel dosimeters of ferric type have been distributed after irradiation that lead to record dosimeter information.[11,12] Gene-pin is a natural cross-linking agent that is form from Yes-man plant fruit.[8] This slowly reacts to produce blue color that is basis on the amount of radiation quaintly. This proven that hydrogel of Gelatin-Gene pin dos not distribute after irradiation[13] and are useful for measurement of doses in surface.[14] The goal, study of developments of gel Dosimeter unplayable for optical 3-dimensional dosimeters.[15] Radio-chromic dosimeters for 3-dimensional dosimeter will response linear from zero to Maximum and useful for radiotherapy and lead to distribution.

3.3. Assessment and Comparison Radio-Chromic Gel Dosimeter and Gel Polymer Dosimeter

A qualities comparison of 3-dimensional gel dosimeter was access in hospital system. Radio-chromic gel was studied by Optical laser CT-Scanner and polymer gel dosimeter was studied by Nuclear Magnetic Resonance (NMR) and was verified with 4% precision. In 3-dimensional matrix of radio-chromic gels, this amount can be increased to 8%, that relates to procedure. Gelpolymer results were sensitive to thermal changes in scan length. The results were compared for two dosimeters and dose plan was designed. In

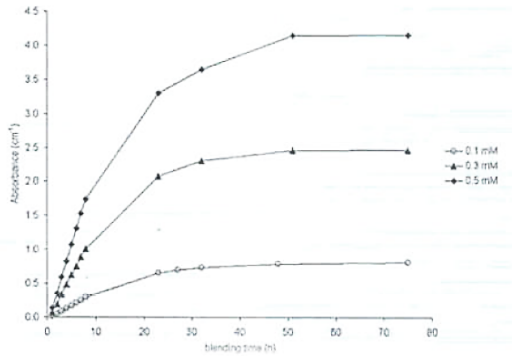

Fig. 4. Reaction between Gelation and Gene-pin concentration changes of Gene-pin and constant concentration of Gelatin without sulfuric acid addition.

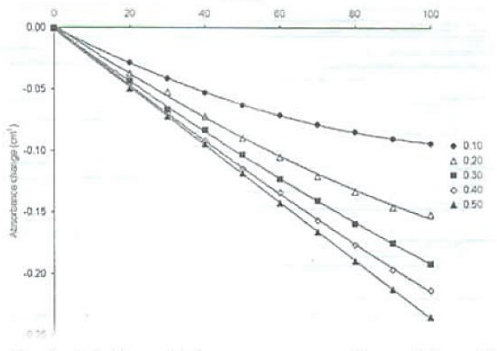

Fig 5. Relation of dose response with variation of concentration of Gene-pin in condition that concentrations of Gelatin, Sulfuric acid and blending time are constant.

measurement of radio-chromic gels, two sources were observed. On the obtained results, gel dosimeters type of proton and chemical were checkable. Gel-polymer dosimeters are for measurements of absolute dose in 3- dimensional with 4% precision. Also, a thermal stabilization technic can be installed for increasing of precision. Anyway, thermal stability was affected for long time measurements.[16]

3.4. Characterization of Gene-pin-Gelatin Radio-Chromic Dosimeter

Cross-linked gelatin with Gen-pin were formed a blue color that responds to radiation. The results of spectrophotometric absorption with higher 100G radiation, obtain a linear response for certain concentration of gel components like gelatin, Gene-pin and sulfuric acid. Dose sensitivity was increased with sulfuric acid and Gene-pin concentrations and depends to cross-linking reaction time of Gene-pin with gelatin. The usual formulation of gels for Gene-pin concentrations is 0.3-0.5 mmol, and at least reaction time is 4 hours. Fig. 4 presents how will be darkness the reaction of Gene-pin-Gelatin to time. The changes of Gene-pin concentration lead to color change after 48 hours. Fig. 4 is for low concentrations of Gene-pin, (0.2 mmol or lower) presents absorption changes to received dose. In 0.1 mmol of concentration, correction coefficients are 1, 0.98 in linear form and in 0.2 mmol of concentration, correction coefficient are 0.9990 and 0.9950 in linear form.

Because, concentration of Gene-pin increases above 0.5mmol, a linear relation can be find 0-100Gy with 0.9990 correction coefficients. The sensitivity increases with releasing of sulfuric acid concentrations in Figs. 4 and 5. These figures present relation dose sensitivity to Gene-pin concentration. Because concentrations of sulfuric acid and Gene-pin increase dose response to blending time were more sensitive.

In this study, was reported with notice to time range and available facilities, we can study on this procedure and alternative materials of Gene-pin. In procedure method, only optimize conditions were determined with and without alternative materials.

4. Conclusions

In this investigation, three-dimensional dose distribution in radio-chromic dosimeter on chemical matrix was performed in micro-scale, and then was obtained measurement after radiation with ionic beams such as gamma-ray. The results of studies presents access to procedure of fabrication plants gel dosimeter in microscale and application as dosimeter in spectroscopic measurements. The method of investigation is chemical method with applying the best ratio of Gelatin/Gene-pin, water; acid sulfuric components and the best condition of reaction were presented.

Conflicts of Interest

The authors declare no conflict of interest.

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