Antioxidant effect of green tea on polymer gel dosimeter

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Antioxidant effect of green tea on polymer gel dosimeter

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Abstract. Extract from Green Tea (GTE) acts as an antioxidant in acrylamide based polymer gel dosimeter. In this work, PAGAT gel was used for investigation of antioxidant effect of GTE.PAGAT was called PAGTEG (Polyacrylamide green tea extract gel dosimeter) after adding GTE. Free radicals in water cause pre polymerization of polymer gel before irradiation. Polyphenols from GTE are highly effective to absorb the free radicals in water. THPC is used as an antioxidant in polymer gel dosimeter but here we were replaced it by GTE and investigated its effect by spectrophotometer. GTE added PAGAT samples response was lower compared to THPC added sample. To increase the sensitivity of the PAGTEG, sugar was added. This study confirmed that THPC was a good antioxidant for polymer gel dosimeter. However, GTE also can be used as an antioxidant in polymer gel if use less quantity (GTE) and add sugar as sensitivity enhancer.

1. Introduction

Advanced radiotherapy requires highly effective 3 dimensional dose verification systems for patient specific quality assurance. Polymer gel dosimeter is an emerging system and serves as good tool for dose verification in radiotherapy [1, 2]. Absorbed dose and the dose can be extracted from different techniques such as Magnetic Resonance Imaging (MRI) [3-5], Optical Computed Tomography (Optical CT) [6, 7], X-ray CT [8, 9], Ultrasound CT (UCT) [10-12] and vibrational spectroscopy [13-15].

Polymer gel consists of toxic ingredients such as acrylamide, Bis-acrylamide and THPC. Utilization of these ingredients is very harmful to individual and the environment. In this study, we replaced one of the ingredients (THPC) from pre-existing PAGAT recipe and analysed their performance for adaptability in clinical applications. Many natural products having good antioxidant activity such as Acai berry, red berry, green tea, turmeric etc [16-18] have good antioxidant activity. Among these, green tea easily available, it does not change in the colour of gel and is easy to prepare its extract. For these reasons, it was chosen for this study. Most of GTE polyphenols are flavonols known as catechin it contains (+) catechin, (-) E picatechin, (-) E pigalloctechin, (-) Epicatechin gallate, (-) Gallocatechin gallate, and (-) Epigallocatechin gallate etc. This catechin consumes the free radicals in water and protects the prepolymerization of gel. Figure 1 shows some major catechin from GTE [19]. Xuping Zhu *et al* [20] and Kwon *et al* [21] reported glucose and urea increase the sensitivity of polymer gel. Since common sugar is the disaccharide of glucose and fructose hypothesis was made that sugar may increase the sensitivity of polymer gel.

2. Materials and Methods

2.1. Green extract preparation

Dried green tea leaves were commercially purchased (Tetley) from Allmart shop -VIT campus - Vellore (India). 1gm of leaves was soaked in 50 ml of Millipore water for 4 hours. The solution was stirred in very low RPM with a magnetic stirrer for 5 minutes. Then the solution was heated to 30 degree Celsius for 30 minutes. After the solution cooled down (Hereafter called Green tea extract) it was filtered and kept in room temperature for PAGTEG preparation.

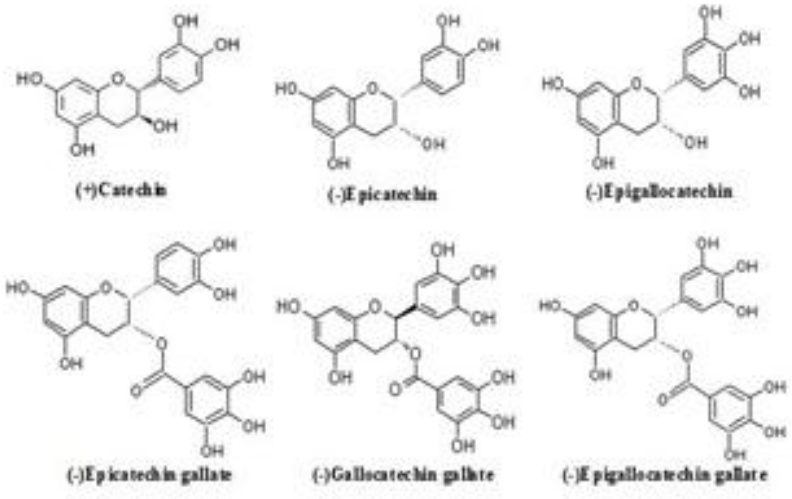

Figure 1. Polyphenol from GTE.

2.2. Gel preparation

PAGTEG was prepared from PAGAT recipe except replacing THPC by GTE. PAGAT preparation is reported in literature [22]. PAGTEG was prepared by adding green tea extract with different concentrations of 0.6%, 1% and 0.23%+2.5 gm of sugar. Gel solution was filled in the plastic cuvettes and kept in a refrigerator for gelation purpose.

2.3. Gel irradiation

Gel samples were irradiated with cobalt-60 (Theratron 780c). Source to surface distance (SSD) was maintained at 80 cm and field size opened for 10×10 cm^2. Samples were irradiated up to 18 Gy with 3Gy interval. After irradiation, the samples were kept at 4 degree for 24 hours to enable it to attain complete polymerization.

3. Results and Discussion

3.1 Spectrophotometry of gel samples

After one day of refrigeration of samples (PAGTEG) they were analysed by double beam spectrophotometer. Un- irradiated gel samples acted as baseline correction samples (Control samples). Samples were read by spectrophotometer before irradiation. All spectrums **(**Not shown) super imposed on each other it denotes that there is no difference in absorption among them and no pre polymerization occurred. Figures 2 and 3 show the UV-Visible absorption spectrum of PAGTEG-1 & PAGTEG-2 (After irradiation). Both spectrums did not show any significant absorption because polyphenols from GTE absorbed most of the free radicals which were formed during irradiation. Due to insufficient quantity of free radicals, polymerization process was almost inhibited by higher concentration of polyphenols from GTE.

Figure 4 shows appreciable absorption spectrum of PAGAT. It contains no GTE. In figure 5 PAGTEG-3 shows very little absorption because PAGTEG-3 contains very less GTE. In addition sugar was also added in that recipe. Combination of Less concentration of GTE and sugar slightly increased the sensitivity of PAGTEG-3 compared with PAGTEG-2&3

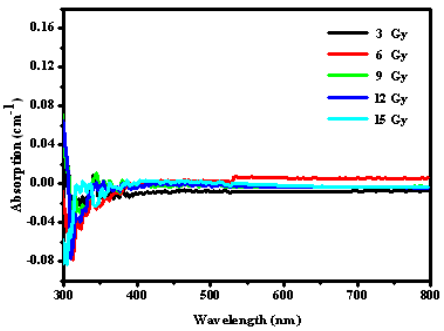

Figure 2. UV-Visible spectrum of PAGTEG-1.

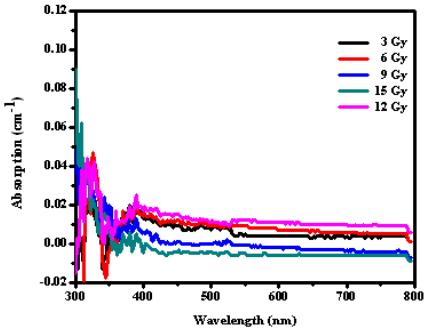

Figure 3. UV-Visible spectrum of PAGTEG-2.

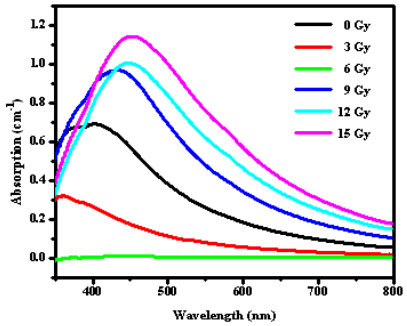

Figure 4. UV-Visible spectrum of PAGAT.

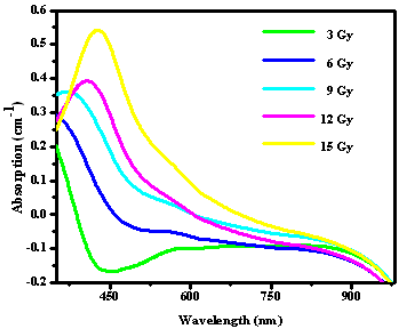

Figure 5. UV-Visible spectrum of PAGTEG-3.

3.2. Particle size measurement of PAGTEG

Particle size was determined for the PAGTEG gel dosimeter from the following equation:

$$2\square = \frac{(\square\square)\square\square\square\square}{\square\square}$$

where *a* is the maximum particle radius, (*Ka*) is the Mie Debye efficiency factor, λ_{max} is the wavelength at which the maximum turbidity is observed and *n* is the refractive index of the gel sample. (*Ka*) is 4.3 [23] Particle size was increased with respect to dose and the Correlation value R^2 =0.98986 showed that a good relation existed between dose and particle size. Figure 6 shows the relation between the particle size and dose.

4. Conclusion

From this study we suggest THPC as the appropriate antioxidant agent for polymer gel dosimetry.GTE acts as a high radiation protector and so inhibit the polymerization process during irradiation by absorbing free radicals. But when GTE is used in lesser quantity (0.23%) with sugar it may allow a little polymerization and we can protect the pre irradiated gel from auto polymerization by adding GTE with less quantity. This study will be extend using the same procedure for different time interval of irradiation and optimize the GTE concentration levels. The tail of study will be continued to find out the nature products for polymer gel dosimetry and eliminate toxic ingredients such as THPC, Acrylamide and Bis- Acrylamide.

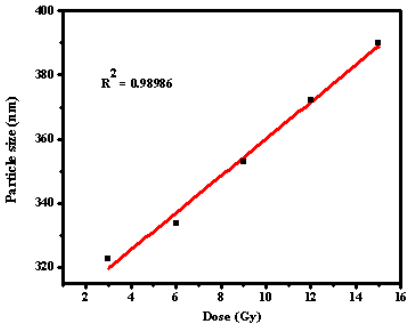

Figure 6. Linear relation between particle size and dose of PAGTEG.

5. Acknowledgements

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6. References

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