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Title of the thesis: **DEVELOPMENT OF BIODEGRADABLE POLYMERIC HYDROGELS FOR BIOMEDICAL APPLICATIONS**

ABSTRACT

The present research work consists of the development of polymeric hydrogels using gum arabic and polyvinylalcohol, biodegradable, food grade and non-toxic water soluble polymers, both natural and synthetic origin following standard methods such as blending, chemical modification, copolymerization and crosslinking and studied the chemical changes, themal and mechanical properties of the hydrogels before and after iodination, using different techniques like ATR-FTIR, TGA, DSC, and mechanical test. Iodine release from iodinated hydrogels in water has been also studied using UV-VIS spectroscopy and iodometric titration techniques. Apart from these studies, antimicrobial activity of the released iodine in water from the iodinated hydrogels was carried out. The objective was to study the applications of the prepared hydrogels in two important areas where iodinated polymers might have the potential to complement the existing systems or devices, for example **in small-scale water disinfection and iodine nutrition through water.** The most interesting part of this research work was the study of interaction of small molecules i.e, iodine with the functionalized polymeric hydrogels.

The blending of GA with PVA and PVP-I has improved its properties and thus the features necessary for the use of the blend as a matrix for release of iodine have been achieved. The crosslinking of GA/PVA blends with glutaraldehyde led to an improvement in water resistance, thermal and mechanical properties.

Thermal stability of GA was found to be increased after acetylation and then decreased after iodination. The t_g of GA was found to be increased after acetylation confirms the acetylation of GA and was also found a decrease in t_g of AGA-3 after iodination confirms the iodine interaction with >C=O group of AGA-3. AGA tablets after coating with EC were found to be stable in water. Grafting was achieved by using different amounts of the monomer, which produced graft copolymer of GA with increasing value of percent grafting that was found to be decreased at high amount of monomer.

Crosslinking reaction between PVA and crosslinkers; malonic and succinic acids followed by iodination with different iodine solutions; iodine-ethanol and I_2/KI aqueous solutions have been estabilished by FTIR study. The thermal stability of PVA has been

found improved after crosslinking with malonic and succinic acids. The difference in the structure of malonic and succinic acids have also shown its effect on thermal stability of crosslinked PVA. The iodinated crosslinked PVA films with different iodinating reagents; iodine-ethanol and I_2/KI aqueous solutions have also shown its effect on thermal stability.

The results of UV-VIS spectroscopy and iodometric titrimetric studies of GA/PVA/PVP-I blend films showed an interaction between the free available iodine of PVP-I and the hydroxyl polymers that affected release profile of the films. It was observed that only iodide ion was released from the crosslinked blend films; the reason behind this could be due to unavailability of free molecular iodine of PVP-I when present in a crosslinked blend. Study of UV-VIS spectra of iodine released from the coated AGA3-3.I_2 tablet and the AGA3-3.I_2 powder confirms the molecular iodine interaction with >C=O groups of AGA-3 and also show the role of coating material as barrier to the release of iodine from the tablet. Iodine released in water from the iodinated crosslinked PVA films in different iodine solutions; iodine-ethanol and I_2/KI aqueous solutions following the same technique showed different types of interaction of iodine with >C=O of crosslinked PVA films. The same study also indicated the role of structure of PMLA and PSA in iodine-polymer interaction.

Iodinated polymeric hydrogel based water disinfectant was prepared to avoid the drawbacks associated with using elemental iodine as the biocidal agent. The iodinated hydrogel based formulation works on a simple slow-release technology and is meant for people who need to purify stored untreated surface water for drinking purpose. These water-insoluble films and coated polymeric tablets slowly release iodine and inactivate the microorganisms. The developed water purifier would have advantages over commercially available water purifying tablet (Potable Aqua®) in terms of cost and residual iodine content in water.

The results of UV-VIS spectroscopy and iodometric titrimetric studies showed that crosslinked GA/PVA/PVP-I blend film containing 20.8% PVP-I is stable and releases iodine that is comparable to nutritionally required dose of iodine for an adult per day. The concentration of released iodide ions in 25 minutes was 193 µg/ml, equivalent to 147 µg iodine/ml water that was within the required level of dietary iodine, an adult can take in a day through approximately 10 grams of salt. The per capita salt consumption in India is approximately 10 grams per day as reported by Bhatnagar et al.