

Details of the Project sanctioned under the Human Resource Development scheme of
Department of Health Research

1. **Project Title:** *Use of Optical Coherence Tomography for monitoring the effect of plant extracts in wound healing.

2. **Category of fellowship:** A (Women Scientist who had break in career)

3. **PI (Name & Address):** Dr.Sunita Shukla
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4. **Qualifications:** M.Sc. Ph.D.

5. **Mentor or Co.PI (Name & Address):** Dr. DeepakBhatnagar
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6. **Duration of the project:** 3 Years

7. **Broad area of Research :** Laser tissue interaction, low level laser therapy, optical imaging in biological tissue by optical coherence tomography (OCT).

7.1 **Sub Area :** Modern Biology

8. **Summary of the Project:** (Give in about 300 words)

We propose to investigate the use of Optical Coherence Tomography (OCT) for monitoring the antibacterial properties of plant extracts like *Ocimum sanctum*, *Azardica indica*, *Catharanthusroseu*, *Curcumin longa*, *Aloe vera* and gall of *Quercus infectoria* etc for the management of wounds in Swiss Albino mice. These natural agents induce healing and regeneration of the lost tissue by multiple mechanism. In the normal wound-healing process, after the inflammatory phase, reepithelialization, thickening of the newly formed epidermis and remodeling of collagen fibers occur in a timely fashion. However, underlying metabolic disturbances or diseases disrupted healing processes. To facilitate a timely decision for correct therapy, it is important to accurately monitor the morphological changes. In clinical practice, wound size, color, odor, drainage and eschar are used for gross evaluation of wound healing. These methods, however, do not provide structural information below the wound

surface and can be very subjective. Histology is the standard method for obtaining the structural details of the wound tissues. However, a biopsy is disruptive and introduces a new wound and can also contaminate the wound, thereby prohibiting repeated assessment of the healing process in the same wound. To overcome these limitations, several non-invasive methods have been investigated. Optical coherence tomography (OCT) an emerging technique, which is of current interest, that is capable of real-time, cross-sectional imaging of biological tissues with a micrometer resolution. OCT can image structures up to 2–3mm in depth for highly scattering tissue, and is thus ideal for assessing cutaneous wound healing and several other cutaneous disorders. In addition, the birefringence of the tissue due to changes in the collagen structure can be recorded by measuring the polarization changes in the scattered light using Polarization-sensitive optical coherence tomography (PS-OCT). Biochemical measurements on expression of different growth factors and cytokines responsible for wound healing will also be carried out.

9. Objectives of the Proposal:

- a. To optimize the herbal dose for acute and chronic wound models.
- b. Vivo monitoring of wound healing: wound healing kinetics in infected and uninfected mice under in-vivo condition will be investigated using a real time OCT imaging.
- c. Evaluation of morphological changes associated with wound healing such as wound edema, reepithelization, collagen matrix, tensile strength in Swiss Albino mice using non-invasive Optical Coherence Tomography (OCT) and correlated with histology.
- d. Investigations on kinetics of lipid peroxidation and antioxidant levels status in wounds with and without herbal extract treatment.
- e. Spatio-temporal measurements on expression of different growth factors or cytokines in wound tissue. Particularly, expression of epidermal growth factor, platelet derived growth factor, receptor, fibronectins, matrix metalloproteinases will be studied by enzyme linked immunosorbent assay (ELISA) and immunohistochemical method.

10. Innovations in the project: (Give in about 100 words): We have used OCT for monitoring the effect of Helium-Neon Laser irradiation on hair follicle growth cycle and healing of bacteria infected and uninfected wounds. The facilities and the methodology developed by Raja Ramanna Center for Advanced Technology (RRCAT, Indore) will be utilized to investigate the effect of herbal extracts on wound healing and to monitor wound edema, reepithelization, collagen matrix and tensile strength. In addition the birefringence of

polarization changes in the scattered light using Polarization-Sensitive Optical Coherence Tomography (PSOCT). Hence, this imaging technique can provide a rapid assessment of morphological changes and provide timely treatment and planning with no side effects as it is non invasive and economical.

11. Significance of the outcome of the project: (Give in about 150 words) OCT an emerging technique that will provide real time, cross sectional imaging of biological tissue, and is thus ideal for cutaneous wound healing and several cutaneous disorders and thereby aid in timely treatment planning. It is a non-invasive technique and causes no damage to underlying and adjacent tissue near the wounds. OCT will replace the histology and other non invasive diagnostic methods such as ultrasound imaging used to examine wound healing, the depth resolution achievable is insufficient to monitor fine structural changes like reepithelization. Also, ultrasound requires matching media in direct contact with the wound surface, which may cause mechanical damage to wound tissue. The results of this study may have application in treatment of wound infections caused by antibiotic resistant bacteria. The results of this study would help in the quantitative assessment of the healing potential of the herbal extracts and may also help in the identification of the molecular mechanism.

12. Relevance in Public Health: Using Phytomedicine for wound healing is not only cheap and affordable but also safe as hypersensitive reaction are rarely encountered with the use of these agents. Optical Coherence tomography (OCT) a non-invasive technique in wound healing allows for one to assess the underlying process in the tissue and thus determines if the wound has undergone a normal healing response, or needed treatment and care. OCT will completely replace excisional biopsy and histology or other diagnostic modalities. However, from the point of view of non-invasive diagnosis of diseases and monitoring of treatment effect overtime, OCT might lead to significant new insights in skin physiology, pathology and therapeutic control of skin disorders.

Buneta Shukla
Signature of the Fellow / Faculty

Ashatnagar

Professor & Head
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