

## Raman and FTIR Spectroscopy of the Keratin as a Potential Tool for Probing Bone Health

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Bone matrix is composed of collagenous and noncollagenous bone proteins. Collagen synthesis, secretions and deposition are coordinated with and dependent on synthesis on the other matrix proteins. The presence of cysteine in forming disulfide bonding is a feature of all noncollagenous bone proteins [1]. It is considerate that cysteine residues within structural proteins and consequent disulfide bonding might result in structure with variable ranges [2, 3]. While the mechanism of the bone formation is not defined yet, the need for cysteine and sulfation of the bone proteins is essential to all. There is an in vivo exchange between inorganic sulphate mainly due to synthesis and decomposition of sulphated glycosaminoglycans, which form the basic body of the bone matrix. Lost of cysteine is expected to influence both indirectly and directly, collagenous and noncollagenous proteins as well. The problem of bone fragility may result from disturbance of metabolism of collagenous and noncollagenous proteins.

Osteoporosis affects the organic and mineral phases of bone resulting in a decrease in resistance to fracture. Patients can suffer osteoporotic fractures despite normal bone mineral density, partly because of unmeasured influences of both the protein and mineral phases of bone that are affected in osteoporosis. There is currently no clinically applicable method of evaluating the health of the protein phase. This work has suggested that changes in the organic phase of bone are reflected in similar proteins, such as keratin, from which fingernails are composed. The proteins in human nail (keratin) and bone (collagen) require sulphation and disulphide bond (S-S) formation, via cysteine, for their structural integrity. A disorder of either process should lead to disordered collagen and keratin synthesis.

We use Raman and FTIR spectroscopy to investigate spectra changes of the nails sourced from osteoporosis patients with respect to those sourced from control group of healthy patients. The method was successful in assessing disulfide bond content of human fingernail. The disulfide bond content of the nails sourced from osteoporosis patients was lower and flatter than that from healthy patient. In protein spectra, the carbon sulphide vibrational band originates from methionine, cysteine and cystine. The content of methionine in human nail is insignificant so the contribution of the C-S and S-S bands must have originated from cysteine and cystine. Therefore, we conclude that reduced cysteine or sulphur's may play a role in nail brittleness and bone fragility. Fluorescence is the phenomena, which make Raman measurements more difficult. In case of nails of osteoporosis patients, the fluorescence is more intensive. So this effect may be another indication of changes in nails and bone structure.

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