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FTIR Investigations on the Structure of Acrylic Resin Based Dental Biomaterials.

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ABSTRACT

Structural analysis of Acrylic Resin based dental materials such as Acralyn H-DB material, DPI-RR Cold cure Acrylic Repair material and H-Quick Ashvin was studied through Fourier Transform Infrared (FTIR) spectroscopy. The results of the present analysis indicated that derivatives were not influenced majorly on structure of Acrylic Resin base dental material

Keywords: Structural analysis, Acrylic Resin based dental materials, Fourier Transform Infrared (FTIR) Spectroscopy

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INTRODUCTION

Infrared spectroscopy may be used to identify the composition of polymers, to monitor polymerization processes, to characterize polymer structure, to examine polymer surfaces and to investigate polymer degradation processes. Fourier Transform Infrared Spectroscopy (FTIR) is one of the most widely used and well-established spectroscopic methods for analyzing and characterize the structure of polymers. FTIR spectroscopy presents a sensitive analysis tool to detect composition changes in biomaterials [1].

Copolymer is a polymer derived from two (or more) monomeric species, as opposed to a homopolymer where only one monomer is used [2]. Copolymerization refers to methods used to chemically synthesize a copolymer. Copolymers may also be described in terms of the existence of or arrangement of branches in the polymer structure [3].

Recently, there have been many materials used for denture base such as Polymethyl methacrylate (PMMA) resin, modified PMMA resin and nylon. The material most often used to fabricate denture base and denture teeth was PMMA resin. PMMA is the most commonly used material due to its good mechanical and physical properties, compatibility with oral tissue, aesthetics, ease of repair and low cost. However, some problems such as denture fracture and wear of the denture teeth still exist. In order to overcome these problems, several attempts were made to modify and improve them Meth Acrylic Acid (MAA), is an organic compound. This colourless, viscous liquid is a carboxylic acid with a characteristic odor. It is soluble in warm water and miscible with most organic solvents. Meth Acrylic Acid is produced industrially on a large scale as a precursor to its esters, especially methyl methacrylate (MMA) and poly (methyl methacrylate) (PMMA). The meth acrylates have numerous uses, most notably in the manufacture of polymers. Meth Acrylic Acid occurs naturally in small amounts in the oil of Roman chamomile [4-6].

Acrylic Resin is a composition of vinyl carboxylic acid derivatives widely useful in dental curing problems as a cement and repair material. This paper investigates the structure of different acrylic resin derivatives such as Acralyn H-DB material, DPI-RR Cold cure Acrylic Repair material and H-Quick Ashvin available in market for dental applications through FTIR spectroscopy

MATERIAL AND METHODS

Dental material samples of acrylic derivatives namely Acralyn H-DB material, DPI-RR Cold cure Acrylic Repair material and H-Quick Ashvin were collected from Asian acrylic dental market division Mumbai, Maharashtra India. The dental material samples were brought to laboratory within 24 hours. Care was taken while collection of specific dental material samples and kept them separately. For study of FTIR, dental materials which are available in different grain sizes as solids are converted into powders at nano levels by using Ball Milling apparatus with 200rpm.

RESULTS AND DISCUSSION

The FTIR spectra of dental acrylic derivatives as shown Fig.1 and the corresponding Vibrational bands are summarized in table.1. In the present investigation wave number verses % T (transmittance) is plotted over the range of 250-4000 cm^{-1} and the peak positions are observed to be varying between 400-2600 cm^{-1} . Among these peak positions at wave number of 418.57, 435.93, and 482.22 cm^{-1} are due to C-N-C bend. 503.44 and 551.66 cm^{-1} carboxylic bonding for all acrylic derivatives. Also, asymmetric stretching vibrations of C-O-C bond from carboxylic bond units are found at 1193.3 and 1244.1 cm^{-1} . Moreover, the peaks at C=C and C=O are observed 1610.61 & 1631.33 cm^{-1} . Acrylates region is identified for 1926.95 & 2644.49 cm^{-1} . The other peaks are because of organic composition C-Cl, C-O and =CH bond stretching variation groups respectively [7](Table.1).

CONCLUSIONS

Vibration spectroscopy has been utilized for the characterization of polymers and other material. Variations in the environment of molecular components of materials are reflected in shifts in absorbance band intensities and positions in the vibration spectra. The spectrum of a material provides insight into the chemical composition of absorbance and how it might be altered during processing. Fourier transform infrared spectroscopy (FTIR) is a powerful analytical technique that has been utilized as a quantitative measure for the

identification and monitoring setting reactions and polymerization of a broad range of dental materials. The present investigation indicates were influenced majorly on structure of Acrylic Resin base dental material

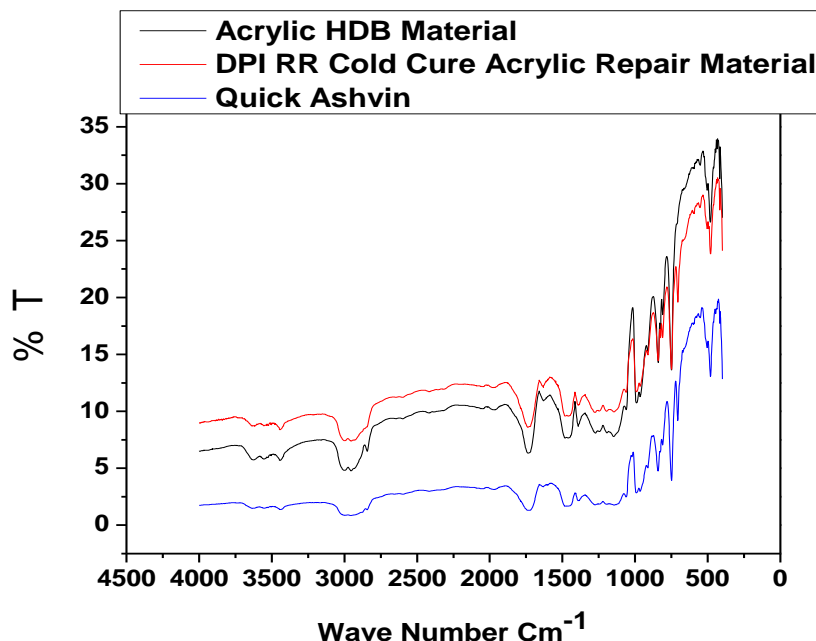
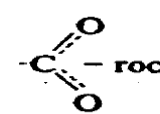


Figure 1: FTIR transmittance spectra of Acralyn base dental biomaterials

Table 1: Peak positions of IR-bands and assignments of vibrational modes

Reported Peaks	Observed Peaks	Vibrational modes
~510-400	~418.57, ~435.93, ~457.14~482.22	C-N-C bend
~500-560	~503.44, ~551.66,	 rocking
~560-850	~592.59,~628.69,671.25,~748.41~825.56	C-Cl Stretch
~950-1000	~964.44,~989.52	=CH Out of plane deformation
~1025-1060	~1020.38,~1060.88	C-O Stretch
~1150-1280	~1147.68,~1193.3,~1244.1	C-O-C Asymmetrical stretch
~1610-1620	~1610.61	C=C stretch doublet
~1635-1680	~1631.33	C=O stretch
~1800-2600	~1926.95, ~2644.49	Acrylates region

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