Introduction

My thesis is mainly on analysis of ragas of North Indian Classical Music. As ragas can be played also I have included some of North Indian classical music instruments to have comparative view. My main purpose is not to compare two instruments but to compare ragas played on that particular instrument with ragas played or sung by other artistes.

In era of Science with newer mathematics, and morden equipment, experimental work is an absolute necessity. Scientific analysis of Music is an area where the least experimental work has been done.

The Indian musical system is modal. In a modal system relation between successive sounds and those between any sound and fixed tonic (Reference note) are of great importance.

'The modal system permits a much more accurate, powerful, and detailed outlining of the expression.'[1]

In modal music, one can have many exotic scales because there are no harmonics. There is only relationship between one note in the scale and sa. Thus, is a seven note scale we have seven relationships.

Furthermore, for Indian classical music, standardization of tonic is not done yet in terms of the frequency and can be defined by the performer according to his/her choice.

'There is no standard pitch like the middle 'C' of western music'[2]

Actual problem arises when the artist does not get his/her tonic (Reference note) from the accompanying instrument i.e. Harmonium and he/she has to compromise by raising or lowering his/her tonic.

In my research work firstly I have tried to standardize tonic (Reference note) and also to assign frequency to 12 notes.

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[1] **Introduction to the study of Musical Scales by Alain Denielou, P.102**
[2] Studies in Indian Music by T.V. Subba Rao, p.7

Secondly, Indian Scholars like Pt.Ahobal, Pt. Shrinivas and Pt. Bhatkhande tried to find out frequency of different notes. They found frequency of (SA) equal to 240 Hz. With the help of (SA) as 240 Hz they found frequencies of other Notes by mathematical ratios. They considered Sa as 240 only for easy arithmetic calculation, as frequency of other notes obtained by it are in whole number compared with the frequencies obtained by selecting Sa other than 240 Hz in which frequency of few notes are in decimal.

'Bharat did not speak of music which was ancient to him. Today more has been written on ancient music than about what we actually sing, play and hear. We are in need of newer knowledge and technique to music.'[3]

Standardization in India has not been done yet as done in western countries. Standardization was done by International Organization for standardization in 1955(and reaffirmed by them in 1975) as ISO 16. More references are given in the coming chapter.

Frequency for C (sa) varies from country to country. In England it is 273 Hz whereas in France it is 261 Hz. Physicists have adopted their standard pitch 512 Hz for C because 512Hz can be expressed as the exact power of 2, namely $2^9 = 512$ HZ.

Some scientific manufacturers once adopted a standard of 256 Hz for middle C, but musicians ignored it [4]

Based on my actual performance and experiment at Physics Laboratory, Faculty of Science, M.S.University of Baroda I found out the frequency for C as 263 Hz.

I have used Shruti Box manufactured by M/s Radal Electronics, Bangalore for standard scale, sound of Shruti Box is amplified through Microphone & Amplifier which were connected to oscilloscope giving the wave pattern. By measuring the time of waveform pattern one can

[3] Psychoacoustics of music & Sppech by B.C.Deva, P.20
[4] Culver, C.A., Musical Acoustics, New York: Mcgraw – Hill, 1956

easily find out frequency, which is 263 Hz. I also found frequency for other Notes, which are given in the thesis.

I have also purchased Computer software from USA based company M/s Regnow, for analysis of Ragas of India Classical Music.

In this software, one can easily find out the frequency of any sound by connecting microphone, Tape recorder or CD to computer. Software shows all frequencies, which are present in that sound up to four harmonics.

I measured frequency of all notes through this software and have found frequency of C of Shruti Box as 263.79 Hz, which is very near to frequency found by my experiment on oscilloscope. In the software, accuracy is more.

I took cassettes of different eminent artistes, analyzed a few ragas of Indian Classical Music through the software, and found the frequency of each swar in each raga and the associated Interval. Using that Interval, I compared ragas of nearly similar notes.

I did four different type of analysis.

1. One Raga - Different Artiste (Sung/played)
2. Different Raga - Different Artiste (Sung/played)
3. One Raga - Sung/played by one artiste at different time.
4. Different raga - one artiste Sung/played