**Abstract**

*Aegle marmelos* (Indian Bael) is a tree which belongs to the family of Rutaceae. It holds a prominent position in both Indian medicine and Indian culture. We have screened various fractions of *Aegle marmelos* extracts for their anticancer properties using in vitro cell models. Gas chromatography-Mass spectrometry (GC-MS) was employed to analyze the biomolecules present in the *Aegle marmelos* extract. Jurkat and human neuroblastoma (IMR-32) cells were treated with different concentrations of the fractionated *Aegle marmelos* extracts. Flow cytometric analysis revealed that optimal concentration (50 µg/ml) of beta caryophyllene and caryophyllene oxide fractions of *Aegle marmelos* extract can induce apoptosis in Jurkat cell line. cDNA expression profiling of pro-apoptotic and anti-apoptotic genes was carried out using real time PCR (RT-PCR). Down-regulation of anti-apoptotic genes (bcl-2, mdm2, cox2 and cmyb) and up-regulation of pro-apoptotic genes (bax, bak1, caspase-8, caspase-9 and ATM) in Jurkat and IMR-32 cells treated with the beta caryophyllene and caryophyllene oxide fractions of *Aegle marmelos* extract revealed the insights of the downstream apoptotic mechanism. Furthermore, in-silico approach was employed to understand the upstream target involved in the induction of apoptosis by the beta caryophyllene and caryophyllene oxide fractions of *Aegle marmelos* extract. Herein, we report that beta caryophyllene and caryophyllene oxide isolated from *Aegle marmelos* can act as potent anti-inflammatory agents and modulators of a newly established therapeutic target, 15-lipoxygenase (15-LOX). Beta caryophyllene and caryophyllene oxide can induce apoptosis in lymphoma and neuroblastoma cells via modulation of 15-LOX (up-stream target) followed by the down-regulation of anti-apoptotic and up-regulation of pro-apoptotic genes.