2. REVIEW OF LITERATURE

Costa et al., (2012) evaluated the immune-modulatory effects of Ocimum gratissimum and rosmarinic acid (RA, a polyphenolic compound) in a murine model of respiratory allergy induced by the Blomia tropicalis (Bt) mite. Methanolic extract of Ocimum gratissimum has therapeutic potential in this murine model of respiratory allergy to a clinically relevant human sensitiser allergen\textsuperscript{20}.

Pereira et al., (2011) prepared Mouth rinse containing Ocimum gratissimum was effective as antiplaque and anti-gingivitis agent, in a similar manner that chlorhexidine digluconate\textsuperscript{21}.

Kpadonou Kpoviessi et al., (2012) studied interaction between the daytime of collection and vegetative stage of the plants and the antimicrobial properties and toxicity of the essential oil of Ocimum gratissimum from Benin\textsuperscript{22}.

Mahapatra et al., (2011) evaluated the immune functions and immune responses in nicotine-induced (10 mM) macrophages and concurrently establish the immunomodulatory role of aqueous extract of Ocimum gratissimum (Ae-Og) and ascorbic acid\textsuperscript{23}.

Shivashankara et al., (2012) reported preclinical observations that Dietary agents (Ocimum gratissimum) in the prevention of alcohol-induced hepatotoxicity 24

Abiodun et al., (2012) reported the anti-trypanosomal activity of Ocimum gratissimum\textsuperscript{25}.

Kamaraj et al., (2011) reported anti-plasmodial potential of Ocimum gratissimum\textsuperscript{26}.

Kar Mahapatra et al., (2011) reported alteration of immune functions and Th1/Th2 cytokine balance in nicotine-induced murine macrophages: immunomodulatory role of eugenol (isolated from Ocimum gratissimum) and N-acetylcysteine \textsuperscript{27}. 
Chang et al., (2010) reported the anti-proliferation effect of caffeic acid (3, 4-dihydroxycaffeic acid), isolated from Ocimum gratissimum Linn, on human cervical cancer cells (HeLa cells)\textsuperscript{28}.

Sam-Wobo et al., (2011) studied the root and leaf extracts of Ocimum gratissimum, for repellent activities against the adults of Simulium damnosum sensu lato\textsuperscript{29}.

Ye et al., (2010) reported that high performance liquid chromatography is a suitable analytical method for determining caffeic acid levels in Ocimum gratissimum, and caffeic acid had anti-proliferative effects on cervical cancer cell lines. Caffeic acid can significantly reduce the proliferation of HeLa cells in a time-dependent manner\textsuperscript{30}.

Bora et al., (2011) reported cerebro protective effect of Ocimum gratissimum against focal ischemia and reperfusion-induced cerebral injury\textsuperscript{31}.

Ghule et al., (2006a) studied the anti-hyperlipidemic effect of four different extract (petroleum ether, chloroform, alcoholic and aqueous) and found that chloroform and alcoholic extract at two different doses (200 and 400 mg/kg, p.o.) showed significant effects in lowering total cholesterol, triglyceride and low density lipoproteins along with an increased in HDL level\textsuperscript{32}.

Mohale et al. (2008) isolated the constituents from Lagenaria siceraria fruit juice extract namely LSN-I, LSN-II and LSN-III and was found to be having anti-hyperlipidemic activity against triton–X induced hyperlipidemia\textsuperscript{33}.

Ghule et al. (2006) evaluated dried extract and methanol extract of L. siceraria fruit for its diuretic activity assessed by measuring different parameters like total urine volume, urine concentration of sodium, potassium and chloride and found that both the extracts (100- 200 mg/kg, p.o.) showed higher urine volume and exhibited dose dependent increased in excretion of electrolytes when compared with respective control\textsuperscript{34}.
Shah et al. (2007) studied the Lagenaria siceraria Stand fruit juice extract (LSFJE) for its analgesic effect using acetic acid induced writhing and formalin induced pain in mice. This study showed a dose dependent inhibition of writhing and also showed a signification inhibition of both phases of the formalin pain test, but with a less intense effect on the first than the second phase (150-300mg/kg, p.o.). Juice extract of L. siceraria also shows anti-inflammatory activity against acute inflammatory models i.e. ethyl phenyl propionate-induced ear edema, carrageenan and arachidonic acid induced hind paw edema model 35.

Shah et al, (2009) studied that acetone extract of fruit epicarp of L. siceraria fruit have maximum antioxidant activity against in vitro model using DPPH36.

Deshpande et al., (2007) showed that fresh juice of the fruit have antiradical activity. The juice as such and its ten times dilution showed radical scavenging activity whereas 100 and 1000 times diluted juice does not show any radical scavenging activity37.

Fard et al., (2008) studied the fruit extract and found effective in CCl4 induced liver damage where it maintained the level of endogenous antioxidant enzymes (superoxide dismutase, catalase and glutathione peroxidase) and marker of lipid peroxidation to that of normal38.

Deshpande et al., (2008) studied ethanol extract of LS and found that LS showed significant prevention in reduction of humoral immune response, cellular immune response and percent neutrophil adhere on in mice in the presence of chemical stressor i.e. Pyrogalol39.

Gangwal et al. (2009) isolated mixture of sterols and two flavonoids from the n-butanol and ethyl acetate soluble fractions of successive methanol extract of Lagenaria siceraria fruit and were identified as oleanolic acid (I), mixture of β-sitosterol (II) and campesterol (III), isoquercitrin(IV) and Kaempeferol (V). All these compounds were tested for immuno-modulatory activity and results showed that Compound I and IV were significantly increased haemagglutination
antibody titre and significantly inhibited delayed type hypersensitivity response in rats compared to control group animals. They also increased rate of carbon clearance from the blood of mice indicating increased phagocytosis\textsuperscript{40}.

**Gopalan et al.** (1996) studied the anti-hepatotoxic activity of different fractions of the ethanolic extract of L. siceraria fruit using the CCl\textsubscript{4}-induced hepatotoxic rats. All fractions tested, in a dose of 250 mg/kg showed significant activity, with the petroleum ether fraction exhibiting comparatively higher activity\textsuperscript{41}.

**Gupta AK et al** (2005) described leaves are emetic and their juice with black pepper is used in headache. The poultice of leaves is used in reducing glandular swelling\textsuperscript{42}.

**Goyal BR et al** (2007) shows, the leaves are anthelmintic, aphrodisiac, cures hallucinations, dry tumors, cough and asthma\textsuperscript{43}.

**Caceres A et al** (1992) has showed anti-inflammatory activity of hot water infusion of leaves against carrageenan induced hind paw edema. The crude ethanolic extract of Moringa dried seeds was tested for anti-inflammatory activity using carrageenan induced inflammation the hind paw of mice by various workers and found to inhibit 85 % of inflammation at a dose of 3 mg/kg body weight, while the mature green seeds inhibited edema by 77 % at the same dose\textsuperscript{44}.

**Siddhuraju P et al** (2003) has evaluated water, aqueous methanol and aqueous ethanol extracts of freeze-dried leaves of Moringa oleifera Lam. from different agroclimatic regions were examined for free radical scavenging capacities and antioxidant activities. All leaf extracts were capable of scavenging peroxyl and superoxyl radicals. Among the three different moringa samples, both methanol and ethanol extract s of Indian origins showed the highest antioxidant activities, 65.1 and 66.8\%, respectively, in the beta-carotene-linoleic acid system. On the basis of the results obtained, moringa leaves are found to be a potential source of natural antioxidants due to their marked antioxidant activity\textsuperscript{45}.
**Lalas S et al** (2002) has described that aqueous, methanol (80 %) & ethanol (70%) extract of freeze-dried Moringa oleifera leaves showed radical scavenging and anti-oxidant activities. All the extracts were capable of scavenging peroxy and superoxydyl radicles. The major bioactive compounds were found to be quercetin and kaempferol. The oil from the dried seeds showed higher antioxidant activity than butylated hydroxyl toluene and α-tocopherol.

**Goel M et al** (2006) has studied leaf extract of Moringa oleifera Lam. in three different solvents (methanol, ethyl acetate and aqueous) reduced sporulation of some fungi, aqueous and methanolic extracts were most effective. HPTLC analysis yield gallic acid in leaves. According to these results, it can be predicted that it has certain substances inhibitory to the fungal spore germination.

**Guevara AP et al** (1999) has screened paste of drumstick leaves for its influence on the carcinogen detoxifying glutathione-S- transferase (GST) activity by more than 78 % in the stomach, liver and oesophagus and showed protective activity against carcinogenesis.

**Pari L et al** (2002) has determined hepatoprotective effect of an ethanolic extract of leaves of moringa on liver damage induced by antitubercular drugs such as isoniazid, rifampicin and pyrazinamide in rat has been evaluated. The extract was found to enhance the recovery from hepatic damage induced by anti-tubercular drugs.

**Rabelo et al.**, (2003) reported the anti-nociceptive effects of the essential oil of *Ocimum gratissimum* L. (Labiatae) (EOOG) in two classical models of pain in male Swiss mice (25-35 g), the writhing test and the formalin test. EOOG possesses interesting antinociceptive properties in the writhing and formalin tests due to relatively low toxicity of essential oil of *Ocimum gratissimum* L. EOOG.

**Pessoa et al.,** (2002) evaluated eugenol against haemonchus contortus, gastrointestinal parasite of small ruminants. The oil and eugenol were diluted in Tween 20 (0.5 %) at five different concentrations. In the egg hatch test, H. contortus
eggs were obtained from feces of goats experimentally infected. At 0.50 % concentration, the essential oil and eugenol showed a maximum ecclodibility inhibition. These results suggest a possible utilization of the essential oil of *Ocimum gratissimum* as an aid to the control of gastrointestinal helminthosis of small ruminants.  

Madeira et al., (2002) reported that EOOG exerts relaxant effects on intestinal smooth muscle, consistent with the popular use of the plant to treat gastrointestinal disorders.

Orafidiya et al., (2001) reported that antibacterial effects, higher than those of commercial antiseptic products at 2 % *Ocimum* oil concentration in some bases. The properties of base into which the oil was incorporated affected its activity. It was more effective in hydrophilic bases than in lipophilic bases. Solubilization and microemulsification grossly reduced its activity.

Kishore Dubey et al., (2000) reported that essential oils showed five chemotypes. An Indian chemotype, with a high level of ethyl cinnamate, presents, in vitro, an interesting spectrum of antifungal properties.

Aguiyi et al., (2000) reported the hypoglycemic effect of the methanolic extract of *Ocimum gratissimum* leaves was evaluated in normal and alloxan-induced diabetic rats. Intraperitoneal injection of the extract (400 mg/kg) significantly reduced plasma levels both in normal and diabetic rats by 56 % and 68 %, respectively.

Offiah and Chikwenda (1999) reported anti-diarrhoeal effects of aqueous extract of the leaves of *Ocimum gratissimum*. The extract inhibited castor oil-induced diarrhoea in rats as judged by a decrease in the number of wet faeces in the extract-treated rats. In addition, the extract inhibited the propulsive movement of intestinal contents.

Nakamura et al. (1999), reported the essential oil (EO) of *Ocimum gratissimum* inhibited Staphylococcus aureus at a concentration of 0.75 mg/ml. The
minimum bactericidal concentration of EO was within a twofold dilution of the MIC for this organism. The compound that showed antibacterial activity in the EO of *O. gratissimum* was identified as eugenol 57.

**Aziba et al.,** (1999) reported the aqueous extracts of *Ocimum gratissimum* in isolated rabbit jejunum (IRJ); rat stomach strip (RSS); and also its analgesic properties in mice. The extract caused a dose dependent inhibition of the rabbit jejunum spontaneous pendular movement 58.

**Martins et al.,** (1999) reported major compounds in the volatile oil of *Ocimum gratissimum* were thymol (48.1 %) and P-cymene (12.5 %) 59.

**Ilori et al.,** (1996) reported the antidiarrhoeal activities of leaf extracts of *Ocimum gratissimum* were by disc diffusion and tube dilution methods. The extracts were active against Aeromonas sobria, Escherichia coli, Plesiomonas shigelloides, Salmonella typhi, and Shigella dysenteriae. The minimum inhibitory concentrations were from 4.00 to 50.00 mg/ml, while the minimum bactericidal concentration ranged from 8.00 to 62 mg/ml 60.