Literature Review

**Alam et al., (2011)**\(^{31}\) studied the anti-inflammatory activity of ethanolic and aqueous extract of fruit of *Ammomum subulatum*. Dose of 100 mg/ml and 200 mg/ml of ethanolic and aqueous extract were evaluated for their anti-inflammatory activity against carrageenan induced paw edema in rat. Both the extracts were able to show anti-inflammatory activity in dose dependent manner as compared with standard drug Diclofenac sodium 100 mg/ml. Ethanolic extract of the fruit of *Ammomum subulatum* produced 48.57% and 60% inhibition and aqueous extract of fruit of *A. subulatum* produced 45.72% and 54.28% inhibition compared to Diclofenac sodium which showed 71.43% inhibition after 5 h (P< 0.001). *Ammomum subulatum* shows a significant inhibition of inflammation, which is comparable to the standard drug.

**Bisht et al., (2011)**\(^{32}\) reviewed that large cardamom contains 8.6% moisture, 5% total ash value, 1.5% ash insoluble in acid, 3.5% water soluble ash value, 4.88% alcohol extract, 4% non-volatile ether extract and 91.4% of total solid. It contains 1.95 to 3.32% of essential oil having characteristic aroma and possesses medicinal properties. The major constituent of large cardamom essential oil is 1,8-cineole. The monoterpenic hydrocarbon content is in the range of 5 to 17% of which lamonene, sabeinene, and pinenes are significant components. The terpinols comprise approximately 5 to 7% of the oil. Due to the presence of these compounds, it has pharmacognostic properties such as analgesic, antimicrobial, cardiac stimulant, carminative, diuretic, stomachic etc.

**Shukla et al., (2010)**\(^{33}\) were investigated methanolic extract and ethyl acetate extract of seeds of *A. subulatum* for the analgesic activity using hot plate method and writhing method. In this method both the extracts of plant showed significant (p<0.001) analgesic action 60 min after its administration. From the results it can be inferred that both methanolic and ethyl acetate extract of seeds of *A. subulatum* possessed significant (p<0.001) analgesic activity.

**Verma et al., (2010)**\(^{34}\) evaluated greater cardamom for its protective effect against stress induced myocardial damage in an animal experimental study. Thirty six guinea pigs were equally divided into three groups. Group I was normal control, fed on stock diet; Group II was drug control received stock diet and Ashwagandha (*Withania somnifera*) 25 mg/kg and Group III was treated group received stock diet and greater cardamom 200 mg/kg daily for 15 days. They were subjected for swimming endurance till exhaustion. Half of the animals in
each group received injection adrenaline 2 ml before the procedure. The level of significance was less in greater cardamom (p<0.01) than in other two groups (p<0.001). When actual reductions in swimming time caused by adrenaline were compared with control the reduction was much more less (44.77%) in greater cardamom group than in the Ashwagandha (32.84%) group. This has offered 62.75% protection against the effect of stress by greater cardamom and 58.38% by Ashwagandha. It is the first time that cardio-adaptogenic property of greater cardamom has been demonstrated.

**Aneja and Joshi (2009)** were studied in vitro antimicrobial activity of Amomum subulatum and Elettaria cardamomum fruit extracts. Both plant extracts were studied against Streptococcus mutans, Staphylococcus aureus, Lactobacillus acidophilus, Candida albicans and Saccharomyces cerevisiae. The acetone, ethanol and methanol extracts of the selected plants exhibited antimicrobial activity against all tested microorganism except L. acidophilus. In case of Amomum subulatum the most susceptible microorganism was S.aureus followed by S.mutans, S.cerevisiae and C.albicans. The largest mean zone of inhibition was obtained with the ethanolic extract of A. subulatum and acetonic extract of E.cardamomum against Staphylococcus aureus (16.32mm and 20.96mm respectively). Minimum inhibitory concentrations (MIC) of the extracts were also determined against the four selected microorganisms showing zones of inhibition ≥10mm. This study depicts that ethanol and acetone extracts of fruits of Amomum subulatum and Elettaria cardamomum can be used as a potential source of novel antimicrobial agents used to cure dental caries.

**Saikat Sen et al., (2009)** showed that Crude methanolic extract of fruits of large cardamom possess antiulcer activity. Antiulcerogenic activity of those fractions like petrol soluble fraction, ethyl acetate soluble fraction, methanol soluble fraction, methanol insoluble fraction and essential oil investigated. Total methnolic fraction (860, 1720 mg/kg), petrol soluble fraction (262 mg/kg), ethyl acetate soluble fraction (196 mg/kg), methanol insoluble fraction (790 mg/kg) and essential oil (200 mg/kg) produce significant ulcer protection against ethanol induced ulcer but methanol soluble fraction (465 mg/kg) found ineffective. Petrol soluble, ethyl acetate soluble, methanol insoluble fraction also found to increase gastric wall mucus in ethanol induced ulcer. So antiulcer effect may due to cytoprotective and strengthening effect on gastric mucosa. Ethyl acetate soluble fraction produce highest activity and shows presence of phenolic compound, may be responsible for gastroprotection effect. Total methanolic extract of the fruit does not show any significant ulcer protection against
aspirin induced ulcer. No fraction found significantly effective against pylorus ligated ulcer. So ulcer protective effect of fraction is involved in direct protective effect of on gastric mucosa.

Yadav and Bhatnagar (2007) showed that the antioxidants in foods play an important role in preventing the generation of reactive oxygen species (ROS). The results show that spices such as cloves (Syzygium aromaticum), licorice (Glycyrrhiza glabra), mace (aril of Myristica fragrans) and greater cardamom (A. subulatum), used in the present study have significant ability to inhibit lipid peroxidation in rat liver homogenate due to their polyphenol content, strong reducing power and superoxide radical scavenging activity. Cloves showed the highest antioxidant activity probably due to the higher polyphenol content as compared to other spices.

Joshi and Joshi (1993) showed that oral administration of 70% methanolic extract of A. subulatum seeds at the doses 150 and 250 mg/kg/day in rabbit showed a significant reduction in the serum and tissue content of total cholesterol, phospholipids and triglycerides. The serum HDL-cholesterol/Total cholesterol ratio was raised whereas LDL and VLDL cholesterol levels were reduced significantly after treatment. The seeds of A. subulatum possessed antioxidant activity as shown by increased GSH and catalase activities and decreased alanodialdehyde (MDA) levels. Histopathological studies showed well developed atheromatous plaques throughout the aorta after cholesterol feeding in comparison to control rabbits. Treatment with A. subulatum exhibited a significant regression in plaque size of aorta. These findings suggest that orally administered A. subulatum could be useful in prevention of hyperlipidaemia and provide antioxidant protection.

Gilani et al., (2006) yielded 1.1 % of oil by hydrodistillation of A. subulatum Roxb. G. C analysis revealed that volatile oil contained 1,8-cineole (55.37 %), terpinyl acetate (11.66 %) and limonene (6.05 %) as major component.

Jamal, et al., (2006) studied crude methanolic extract (TM), essential oil (EO), petroleum ether soluble (PS) and insoluble (PI) fractions of methanolic extract, were studied in rats at doses of 100–500, 12.5–50, 12.5–150 and 450 mg/kg, respectively for their ability to inhibit the gastric lesions induced by aspirin, ethanol and pylorous ligature. In addition their effects on wall mucus and gastric acid output were recorded. All fractions (TM, EO, PS, PI) significantly inhibited gastric lesions induced by ethanol and aspirin but not those induced by
pylorus ligation. PS extract at doses ≥12.5 mg/kg proved to be more active than ranitidine at 50 mg/kg.

Ravichandran et al., (2005) has evaluated the efficacy and safety of Anti-Wrinkle cream containing A. subulatum in the treatment of facial skin wrinkles by prospective, open, phase III clinical trial and showed that the active constituents of A. subulatum (protocatechualdehyde and protocatechuic acid) have potent antioxidant activity.

Naik et al., (2004) showed that the pericarp (husk) of A. subulatum Roxb. yielded 0.18% volatile oil by Clevenger hydrodistillation method. This oil was analysed for physical parameters viz. specific gravity (0.9148), refractive index (1.4733) and optical rotation (-7.700). The V. oil was subjected to GC-MS analysis and 37 compounds were identified, constituting > 98% of the total oil. The major compounds characterized were 1,8-cineole (38.7%), α-pinene (13.6%), α-terpineol (12.6%), spathulenol (8.3%), 4-terpineol (4.5%), germacrene-D (3.0%), β-pinene (2.8%) and α -selinene (2.7%). GC and GC-MS data revealed that the 1,8-cineol content was less than 50% when compared with the seed oil.

Rout et al., (2003) obtained oil by hydrodistillation of the seeds of green, freshly dried and those available in the local market of A. subulatum Roxb. and analyzed by GC and GC/MS. A total of 33 components were identified by mass spectra and relative retention indices. The major component of the oil was 1, 8-cineole (81.5-86%).

Jafri et al., (2001) has showed that the fruit of A. subulatum Roxb, commonly known as 'Heel kalan' or 'Bari Ilaichi' is used in Unani system of medicine in gastrointestinal disorders. The results suggest a direct protective effect of ethyl acetate fraction on gastric mucosal barrier. While the observation of decrease in gastric motility by essential oil and petroleum ether fractions suggest the gastroprotective action of the test drug. These investigations validate the use of A. subulatum Roxb in gastrointestinal disorders by Unani physicians.

Kikuzaki et al., (2001) has isolated protocatechualdehyde, Protocatechuic acid, 1,7-bis (3,4-dihydroxyphenyl) hepta-4E,6E-dien-3-one and 2,3,7-trihydroxy-5-(3,4-dihydroxy-E- styryl)-6,7,8,9-tetrahydro-5H-benzocycloheptene and showed its antioxidant acivity.

Dhuley (1999) showed that in order to gain insight into the antioxidant effect of cinnamon (C. verum; Lauraceae) and cardamom (A. subulatum; Zingiberaceae) hepatic and cardiac antioxidant enzymes, glutathione (GSH) content and lipid conjugated dienes were studied in
rats fed high fat diet along with cinnamon or cardamom. The antioxidant enzyme activities were found to be significantly enhanced whereas GSH content was markedly restored in rats fed a fat diet with spices. In addition, these spices partially counteracted increase in lipid conjugated dienes and hydroperoxides, the primary products of lipid peroxidation. Thus, it appears that these spices exert antioxidant protection through their ability to activate the antioxidant enzymes.

Qureshi et al., (1997) studied the effect of extract of 18 plant species, viz., A. calamus, A. vasica, A. subulatum, A. paniculata, B. diffusa, C. occidentalis, C. asiatica, C. citratus, H. indicus, H. suaveolens, Malvestrum sp., P. edulis, P. daemia, P. bicalyculata, S. hirsuta, S. nigrum, T. stans, and V. chinense on the growth of Microsporum gypseum, Chrysosporium tropicum and Trichophyton terrestre. The sensitivity of the keratinophilic fungi was evaluated by dry-weight method. The maximum inhibition of mycelial growth was shown by M. gypseum (86.62%) followed by T. terrestre (81.86%) and C. tropicum (74.06%) when treated with S. hirsuta whereas the minimum inhibition was exhibited by M. gypseum (0.29%), C. tropicum (0.16%) and T. terrestre (1.76%) when tested with the extract of P. edulis, A. vasica and B. diffusa respectively.

Gurudutt et al., (1996) analyzed the oil vising GC/MS and identified 25 components of which 16.3% were monoterpenic hydrocarbons and 75.3% were of oxygenated monoterpenes with 1,8-cineole (61.3%), being the major component.

Dubey et al., (1990) showed that the oil from the leaves of A. subulatum exhibited 100 % fungi toxicity against Aspergillus flavus, Trichophyton Mentagrophytes and Microsporum gypseum. The oil in concentration of 1000 ppm showed moderate mycelial inhibition against Microsporum ausouinii and Trichophyton Mentagrophytes.

Amomum subulatum is an important ingredient in Ayurvedic formulations like sarivadyasa, Karpuradyarka, Kalyanaka ghrta, Vastyamayanntaka Ghrtta, Manasmitra Vatika.

Singh and Aswal (1992), Singh (1993) reviewed that the A. subulatum seeds are stomachic and are used in neuralgia, gonorrhoea, fever, piles and oral troubles.

A. subulatum seeds are acrid, bitter, aromatic, thermogenic, deodorant, appetizer, carminative, digestive, stomachic, constipating, cardiac and liver tonic, expectorant, diuretic,
febrifuge and hypnotic. They are used in various conditions of kapha and vata, halitosis, anorexia, dysentery, skin disease, pruritis, wounds, ulcers, cephalagia, odontalgia, neuralgia, cardiac debility, liver congestion, splenomegaly, cough, bronchitis, stangury, fever proctoptosis, hyperdipsia and gonorrhoea. They are similar in properties to the cardamom for which they are often substituted both as a spice and as masticatory or as an ingredient of chewing preparation. In south India, Amomum subulactum is used in the preparation of snuff and agarbatties.28

A decoction of A. subulatum seeds is used as a gargle in affections of teeth and gums.27 With melon seeds, Amomum subulatum used as a diuretic in cases of gravel of kidneys.28 It promote elimination of bile and are useful in congestion of liver. They are also used in gonorrhea28.

A. subulatum is the herb which provides a soothing effect on broncho pharangial region and has a bronco sedative action.27

In large doses with quinine, they are useful in neuralgia. The pericarp is useful in headache and heals stomatitis. The aromatic oil extracted from the seeds is applied to the eyes to allay inflammation.28