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Potentiating immunity of dairy animals during transition period through herbs - A review

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ABSTRACT

India has a rich diversity of medicinal plants and traditional knowledge on herbal medicine to treat the animals has both curative and preventive roles. Immunity of the animals affects the is production potential. Strengthening of non-specific immunity of the parturient animals can be used as an alternative approach to overcome the incidence of diseases in the peri and postpartum period where in these animals are more prone. One of the promising technologies is the use of immunomodulators to boost the immunity of animals during the transition period. Immunomodulators can be of natural or synthetic origin, which helps in boosting up the immunity for overcoming stress-related ailments, inhibition of reactive oxygen species generation and scavenging of free radicals to ensure the general wellbeing of animals. In the recent years, several different approaches have been examined to investigate the effect of various herb extracts and minerals as immunopotentiator separately. In literature many plants have been listed having immunomodulatory effect and some of them have been proved to have active principles with immunomodulatory, antioxidant, analgesic, antipyretic and antimicrobial properties. The present compilation deals with some of such medicinal plants like *Anethum graveolens* (Sowa), *Elettaria cardamomum* (Bari elaichi/Cardamom), *Foeniculum vulgare* (Saunf), *Trachyspermum ammi* (Ajwain), *Zingiber officinale* (Sundh) and *Trigonella foenun- graceum etc.*

Key words: Anethum graveolens, Elettaria cardamomum, Foeniculum vulgare, Immunity, Transition period, Trachyspermum ammi, Trigonella foenun- graceum, Zingiber officinale.

The transition period of dairy animals, defined as 3 weeks pre-calving to 3 weeks post-calving (Grummer, 1995), is the most critical weeks of the production and reproduction cycle as it decides the performance of the animals imparts the level of success realized during the subsequent lactation (Defrain, 2005). During this critical period, the animal's metabolism shifts from the demands of pregnancy to those of lactation, with increased demands for energy and protein. There are chances of decline in feed intake around parturition and higher lipid mobilization, to cope up with the stress which leads to severe negative energy balance and low serum or plasma concentrations of several minerals and vitamins, resulting in compromised health status (Goff, 2006). High physiological and biochemical reactions leading to increase in the production of reactive oxygen species (ROS) which causes immunosuppression (Sordillo, 2005), as immune cells are sensitive to oxidative stress and high concentrations of polyunsaturated fatty acids that are very susceptible to peroxidation. A number of components of host defense system are altered during this period including neutrophil function, lymphocyte sensitivity to the mitogen stimulation, antibody responses and cytokine production by immune cells (Kehrli *et al*., 2006). The increased challenge to pathogenic microorganisms and decreased animal resistance renders animal more susceptible to various infectious and non-infectious diseases during the transition period (Goff, 2000). These diseases have considerable negative impact on the profitability of dairy farming and jeopardize the success of the dairy farm. Strengthening the immunity of parturient animals around calving by giving various immune modulators to overcome the health problem of animals is of utmost concern and is the only perspective to overcome the incidence of diseases during the transition period of parturient animals through herbal interventions.

***Anethum graveolens* (Sowa):** *Anethum graveolens* is commonly known as dill. The generic name "Anethum" is derived from the Greek word "anethon" and the comes from the Old Norse word, dylla or dilla which means "to soothe" (Singh and Panda, 2005). It has been cultivated in the Mediterranean region, Europe and central southern Asia since antiquity. It grows throughout India, mainly in Punjab, Uttar Pradesh, Gujarat, Maharashtra, Assam and west Bengal (Kaur and Arora, 2010). The brown coloured fruits of sowa

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are tinny, oval and flat. It contains essential oils, fatty oil, moisture (8.39%), proteins (15.68%), carbohydrates (36%), fibre (14.80%), ash (9.8%), mineral elements (calcium, potassium, magnesium, phosphorous, sodium) and vitamin (vitamin A and niacin). Fruits of *Anethum graveolens* contain 1-4% essential oil comprising of major compounds, i.e. carvone (30-60%), limonene (33%) and alpha-phellandrene (20.61%) (Ishikawa *et al*., 2002). Antibacterial activity of aqueous and organic seed extracts of *Anethum graveolens* was assessed using agar diffusion assay to ascertain their antibacterial effect. It has good antibacterial activity against all the bacteria except *Klebsiella pneumonia* and one strain of *Pseudomonas aeruginosa*. Minimum inhibitory concentration for aqueous and acetone seed extracts ranged from 20–80 mg/ml and 5–15 mg/ml, respectively (Kaur and Arora, 2010). Heamalatha *et al*. (2011) have also been reported that the *Anethum graveolens* used as antimicrobial, antispasmodic, antidiabetic, antihyperlipidemic, antihypercholesteromic and anti-inflammatory activity. Anethole (sowa) has been reported to be a safe antithrombotic agent due to its antiplatelet activity, clot destabilizing effect and vaso-relaxant action (Tognolini *et al*., 2007).

Ugulu *et al*. (2009) demonstrated that the *Anethum graveolens* used as a carminative and stomachic purposes in Anatolian folk medicine. Hosseinzadeh *et al*. (2010) studied that the *Anethum graveolens* seed extracts have effective antisecretory and anti-ulcerative activity against HCl and ethanol-induced stomach lesions with and also recognized as the biologically active molecules possessing oestrogenic, acaricidal and antithrombotic activities (Manzoor *et al*., 2012).

Elettaria cardamomum **(Bari elaichi/Cardamom)**: *Elettaria cardamomum*, commonly known as true cardamom, in India, is known as the 'Queen of Spices' (Abraham, 1965). It is native to southern India and it's cultivated in Nepal, Vietnam, Thailand and Central America. In India, the states of Sikkim and Kerala are the main producers of cardamom. The essential oil of *Elettaria cardamomum* were contain α-terpinyl acetate (44.3%), 1,8-cineole (10.7%), α-terpineol (9.8%) and linalool (8.6%). *Elettaria cardamomum* (Bari elaichi/Cardamom) seeds have analgesic (Al-Zuhair *et al*., 1996), anti-inflammatory (Sapra *et al*., 2000; Majdalawieh and Carr, 2010), antioxidant (Nair *et al*., 1998; Singh *et al*., 2008) antimicrobial activities on *bacterial and fungal cultures such as Pseudomonas aeruginosa, Mycobacterium smegmatis, Klebsiella pneumonia, Staphylococcus aureus, Escherichia coli, Salmonella typhimurium, Enterococcus faecalis, Micrococcus luteus and Candida albicans* (Elgayyar *et al*., 2001; Agaoglu *et al*., 2005; Singh *et al*., 2008; Kaushik *et al*., 2010), anti-spasmodic (Al-Zuhair *et al*., 1996) and platelet aggregation activities (Suneetha *et al*., 2005).

Foeniculum vulgare (Saunf): Foeniculum vulgare commonly known as fennel, is derived from the Middle English fenel or fenyl. The word Foeniculum came from the Old English fenol or finol, which "hay". *Foeniculum vulgare* is mainly grown in northern Europe, United State, southern Canada, and most part of the Asia and Australia (Biota, 2014; Calflora taxon report, 2014). It contains 42.3% carbohydrates, 10% fat, 9.5% protein, 13.4% minerals, 6.3% of moisture and 18.5% fibre. The minerals and vitamins present in F. vulgare are calcium, potassium, sodium, iron, phosphorus, thiamine, riboflavin, niacin and vitamin C. (Rather *et al*., 2012). Major phytoconstituents of the *Foeniculum vulgare* are phenols, phenolic glycosides, trans-anethole, estragole and fenchone (Rather *et al*., 2012). Different pharmacological experiments in a number of in vitro and in vivo models have convincingly demonstrated the ability of *Foeniculum vulgare* by researchers. Ashish *et al*. (2013) investigated the effect of boiling of fennel (100°c for 30 min) and roasting (160 °C for 15 min) on the levels of these phytochemicals. Boiling resulted in a significant decrease in the levels of polyacetylenes (falcarindiol- 3-acetate, falcarinol and falcarindiol) and polyphenols (gallic acid, caffeic acid, ferulic acid and phloridzin). Biological activities of essential oil (EO) of fennel seeds have been reported by various workers i.e. antibacterial (Dadalioglu and Evrendilek, 2004; Cantore *et al*., 2004; Mahady *et al*., 2005; Mohsenzadeh, 2007; Kaur and Arora, 2010), antifungal (Singh *et al*., 2006), acaricidal (Lee, 2004), antioxidant (Ruberto *et al*., 2000; Han *et al*., 2006; Faudale *et al*., 2008), antithrombotic (Dadalioglu *et al*., 2004; Tognolini *et al*., 2007), hepatoprotective (Özbek *et al*., 2003), anti-inflammatory (Choi and Hwang, 2004), antitumour (Pradhan *et al*., 2008), antidiabetic activity (El-Soud *et al*., 2011) and aphrodisiac (Pliny's, 1942).

Hare *et al*. (1916) reported that Saunf (fennel / aniseed) when occasionally used, increases the lacteal secretion, and helps in establishment of the menstrual flow. Dodds *et al*. (1938) investigated the effects of fennel constituents, who developed the first humanly synthesized, orally effective estrogen. Reynolds, (1982) Fennel essential oil (FEO) used in the pediatric colic and some respiratory disorders due to its anti-spasmodic effects. Agarwal *et al*. (2008) reported that the extracts of fennel seeds have a potential use in the treatment of glaucoma, as a diuretic and a potential drug for the treatment of hypertension and its use as a galactagogue. It's galactagogue properties have been attributed due to the presence of phytoestrogens present in fennel which promote the growth of breast tissue. Manzoor *et al*. (2012) describe that the *Foeniculum vulgare* used as a carminative, digestive, lactagogue and diuretic and in treating

respiratory and gastrointestinal disorders. Ostad *et al*. (2001) reported that the inhibitory effect of FEO on the response of uterine tissue when treated by oxytocin and PGE_2 respectively. Camejo-Rodrigues *et al*. (2003) also studied that the *Foeniculum vulgare* exhibits free radical scavenging, superoxide anion radical scavenging, hydrogen peroxide scavenging, and metal chelating activities.

***Trachyspermum ammi* (Ajwain):** *Trachyspermum ammi*, commonly known as Bishop 's weed, carom seed (English names) and Ajwain or ajwain or omum in Indian languages, is a herbaceous herb belonging to the family Apiaceae and vastly grows in Egypt, Iran, Pakistan, Afghanistan, and India as well as European region. In India, it is cultivated in Madhya Pradesh, Uttar Pradesh, Gujarat, Rajasthan, Maharashtra, Bihar and West Bengal. The herb is generally grown in October-November and should be harvested in May-June (Shojaaddini *et al*., 2008; Chauhan *et al*., 2012). Usually, grayish brown seeds or fruit of ajwain are considered for medical and nutritional purposes (Chauhan *et al*., 2012). A number of chemical constituents have been reported in Ajwain seeds. Its contain fibre (11.9%), carbohydrates (38.6%), tannins, glycosides, moisture (8.9%), protein (15.4%), fat (18.1%), saponins, flavone and mineral matter (7.1%) containing calcium, phosphorous, iron and nicotinic acid (Pruthi *et al*., 1992). The Ajwain fruits accumulate up to 5% brownish essential oil (Minija *et al*., 2002). Usually, Thymol (35% to 60%) is the main essential oil constituent (Ishikawa *et al*., 2001). The nonthymol fraction (thymene) contains carvone (46%), limonene (38%), and dillapiole (9%) (Choudhury *et al*., 1998). Thymol is the main constituent of ajwain. It has the antimicrobial properties which can be helpful to keep the animal healthy. Essential oil (EO) of *Trachyspermum ammi* is inhibits deamination and also reduces methane production (Calsamiglia *et al*. 2007). Krishnamoorthy and Madalageri, (1999) reported that the seed of Ajwain is bitter, pungent, and acts as anthelmintic, carminative, laxative, and stomachic. It also cures abdominal tumors, abdominal pains, and piles. Ajwain seeds contain an EO containing about 50% Thymol which a strong germicide, anti-spasmodic and fungicide. Ajwain seeds are an important remedial agent for flatulence, atonic dyspepsia, and diarrhea. Moazeni *et al*. (2012) in his study on Ajwain (Trachyspermum ammi) has shown medicinal properties of this herb, in his study the scolicidal effect of the EO from the fruits of this herbal plant was investigated. Zaman *et al*, (2011) showed that collectively *A. indica, N. tabacum, C. procera* and *Trachyspermum ammi possess in vitro and in vivo* acaricidal activities, thus, justifying the traditional use of one or more of these plants against ticks.

***Trigonella foenum-graecum* (Methi):** *Trigonella foenum-graecum* is one of the most promising medicinal herbs, known from ancient times. (Thomas *et al*., 2011). It is commonly known as Greek hay/Methi/bird's foot. It is cultivated in the Near East mainly in India, Pakistan, Nepal, Afghanistan, Iran, Bangladesh, Morocco, Turkey, Egypt, France, Argentina and Spain. Fenugreek production in India is concentrated in the states of Rajasthan, Uttarakhand, Madhya Pradesh, Maharashtra, Punjab, Gujarat, Haryana and Uttar Pradesh. Rajasthan accounts for over 80% of India's output (Parthasarathy *et al*., 2008). Seeds of fenugreek are yellow to amber-colored, frequently encountered in the cuisines of the Indian subcontinent, with for preparation of pickles, vegetable dishes, *daal*s, and spice mixes such as *panch phoron* and *sambar* powder. It contains Flavonoids like rutin, vetexin, quercetin, saponins like fenugrin B, Graecunins, fenugreekine, amino acids like as 4-Hydroxyisoleucine, Histidine, isoleucine, lysine, Leucine and Alkaloid- trigonelline.

Sharma (1986) reported that the *Trigonella foenum-graecum* (Fenugreek) leaves are consumed widely in India as a green, leafy vegetable and are a rich source of calcium, iron, β-carotene and other vitamins. The seeds of *Trigonella foenum graecum* are reported to possess hypoglycemic properties in both animals (Shani *et al*., 1974; Ribes *et al*., 1984) and human (Madar *et al*., 1988; Madar and Arad, 1989; Sharma *et al*., 1990). Raghuram *et al*. (1994) demonstrated that *Trigonella foenum-graecum* (Fenugreek) exerts a hypoglycemic effect by delaying glucose absorption and enhancing is also utilization. Medicinal uses of *Trigonella foenum-graecum* include its use as, antioxidant (Kaviarasan *et al*., 2007), anti-inflammatory and anti-pyretic (Ahmadiani *et al*., 2001), anti-neoplastic (Sur *et al*., 2001), anti-ulcer (Jayaweera, 1981; Al-meshal *et al*., 1985), wound healing (Taranalli and Kuppast, 1996), CNS stimulant (Natrajan *et al*., 2007), immunomodulatory (Bilal *et al*., 2003), and antidiabetic activity (Al-Habori and Raman, 1988; Ravikumar and Anuradha, 1999). Vaghasiya (2001) reported a herbal formulation comprising of 2 kg pearl millet (Pennisetum americanum) grain, 100g of methi (*Trigonella foenum-graecum*) seeds, 50 g of asalio (Lepidium sativum), 25 g of suva (Anethum graveolens) and 500 g of jaggery, helped in expulsion of placenta after parturition. The above mixture was boiled and cooked for one hour after adding water. The cooked feed (after cooling) was fed to cow or buffalo after parturition. Rajkumar (2004) treated anoestrus cows using two herbs *Trigonella foenum-graecum* (Methi at the dose rate of 200 g-1 day-1) and Saraca asoca (Asoka at the dose rate of 50 g-1 day-1) in two separate groups of cows and reported the induction of anoestrus in 83.33% and 66.66% cows and conception in 54.54% and 22.22% cows of the two treated groups. He observed higher levels of estradiol hormone in the treated groups than control.

***Zingiber officinale* (Sundh):** *Zingiber officinale* (Zingiberaceae) originated from Southeast Asia and it is cultivated all over tropical and subtropical Asia (50% of the world's harvest is produced in India), South America and

several countries of the African continent. *Zingiber officinale* contains a number active ingredients i.e. Zingiberol, shogaoles and zingiberene (Govindarajan, 1982). *Zingiber officinale* has been proved to have several pharmacological activities, such as antiviral (Denyer *et al*., 1994), antimotion and antinauseant (Qian and Liu, 1992), anti-inflammatory (Thomson *et al*., 2002; Penna *et al*., 2003; Grzanna *et al*., 2005; Jiang *et al*, 2006), antithrombotic (Thomson *et al*., 2002), antiulcerogenic (Al-Yahya *et al*., 1989), antioxidant (Shobana and Naidu, 2000; Jagetia *et al*. 2003; Stoilova *et al*., 2007; Singh *et al*., 2008; Amir *et al*., 2011), antiparasitic (against Toxoplasma gondii) (Choi *et al*., 2013), antimicrobic activity (Salie *et al*.,1996; Ficker *et al*. 2003; Singh *et al*., 2008). Shirin and Prakash (2010) reported that the free radical scavenging activity, reducing power and total antioxidant activity was found in case of 80% methanol and 80% ethanolic extracts. Penna *et al*., (2003) studied the effect of an extract of *Zingiber officinale* in mice, resulted in prevention of the gastric ulcerations induced by HCl and ethanol. Chang *et al*.(2011) studied that the antiproliferative effect of steamed ginger at 120^0C for 4 h was approximately 1.5-2 fold higher than that of dried and fresh ginger.

Effect of poly-herbal mixture (Karrah) on immune parameters of Murrah buffaloes: Chandra *et al*. (2016) reported that the effect of poly herbal mixture supplementation on post-partum reproductive performance in Murrah buffaloes. The poly herbal mixture was made by mixing 25 gram each of *Foeniculum vulgare* (Saunf), *Trachyspermum ammi* (Ajwain), *Trigonella foenum-graecum* (Methi), *Zingiber officinale* (Sundh), *Anethum graveolens* (Sowa), *Elettaria cardamomum* (Cardamom) and 25-gram black salt (Kala Namak). This mixture was boiled for about 20-30 minutes till half of water remained, then 250 grams of Jaggery (Gur) added and heated for 5-10 minutes, prepared to be mixed with 1.5 kg of concentrate mixture and fed to the buffaloes of supplemented groups after parturition for seven days in the morning hours, improved the immunity level of Murrah buffaloes. Significantly Lower ($p<0.05$) percentage of neutrophil and significantly higher ($p<0.05$) phagocytic activity and myeloperoxidase activity were indicates the better immunity status in these buffaloes to fight with the periparturient stress.

CONCLUSION

Feeding of poly-herbal like, Anethole (Carminative, stimulant, stomachic, mildly diuretic, galactagogue, antimicrobial, anti-inflammatory, antihypercholesterolemic and antihyperlipidemic activities), *Asparagus racemosus* (enhanced milk production), *Elettaria cardamomum* (analgesic, anti-inflammatory, anti-microbial, antioxidant and anti-spasmodic activity), *Foeniculum vulgare* (galactagogue. carminative, Hepatoprotective, Antioxidant, Free radical scavenging, superoxide anion radical scavenging, hydrogen peroxide scavenging, metal chelating, anti-inflammatory, antifungal, antibacterial, acaricidal activity), *Trachyspermum ammi* (carminative, laxative, stomachic and anthelmintic), *Trigonella foenum-graecum* (Immunomodulatory, antioxidant, antidiabetic, anti-inflammatory and anti-pyretic) and *Zingiber officinale* (antioxidant, anti-inflammatory and anti-pyretic) during transition period, may be healful in reduction of peripartum stress by improving immune status and, beneficial effect on productive and reproductive performance of the animals.

REFERANCES

Abraham P. (1965). The cardamom in India. [Kachroo P. (ed.)] Farm. Bull. (New Series). ICAR, New Delhi 37: 1-46.

Agaoglu, S., Dostbil, N. and Alemdar, S. (2005). Antimicrobial effect of seed extract of cardamom (*Elettarýa cardamom* Maton). *YYÜ Vet Fak Derg*, **16** (2): 99, 101, 477-480.

Agarwal, R., Gupta, S.K., Agarwal, S.S., Srivastava, S. and Saxena, R. (2008). Oculohypotensive effects of *Foeniculum vulgare* in *experimental* models of glaucoma. *Indian J. Physiol. Pharmacol*, **52**: 77–83.

Ahmadiani, A., Javan, M., Semnanian, S., Barat, E. and Kamalinejad, M. (2001). antiinflammatory and antipyretic effects of *Trigonella foenum- graecum* leaves extract in the rat. *J. Ethnopharmacol*., **75**(2): 283-286.

Al Meshal, I. A., Parmar, N. S., Tariq, M. and Ageel, A. M. (1985). Gastric anti-ulcer activity in rats of *Trigonella foenum-graecum* (Hu-Lu-Pa*) Fitoterapia*, **56**: 232-235.

Al-Habori, M. and Raman, A. (1988). Antidiabetic and hypocholesterolemic effects of fenugreek. *Phyto. Res*., **12**: 233–242.

Al-Yahya, M. A., Rafatullah, S., Mossa, J. S., Ageel, A. M., Parmar, N. S. and Tariq, M. (1989). Gastroprotective activity of ginger *Zingiber officinale*, in albino rats. *The American journal of Chinese Medicine*, **17**:51-56.

Al-Zuhair, H., El-Sayeh, B., Ameen, H. A. and Al-Shoora, H. (1996). Pharmacological studies of cardamom oil in Animals *Pharmacol. Res*., **34** (1): 79-82.

Amir, M., Khan, A., Mujeeb, M., Ahmad, A., Usmani, S. and Akhtar, M. (2011). Phytochemical analysis and in vitro antioxidant activity of *Zingiber officinale*. *Free Radicals and Antioxidants*, **1**(4), 75-81.

Ashish, R., Hossain, M. B., Patras, A., Tuohy, M. and Brunton, N. (2013). Effect of boiling and roasting on the polyacetylene and polyphenol content of fennel (*Foeniculum vulgare*) bulb. *Food Research International*, **50** (2), 513-518.

Bilal, B.H., Rizwarul, H., Suhel, P., Suwarna, P., Iqbal, S. and Raisuddin, S. (2003). Immunomodulatory effects of fenugreek extract in mice. *Int. Immunopharmacol*, **3**: 257–265.

Calflora taxon report, (2014). University of California, *Foeniculum vulgare* Miller, Biscuit root, fennel, sweet fenne.

Calsamiglia, S. , Busquet, M. , Cardozo, P. W. , Castillejos, L., Ferret, A. and Fandiño, I. (2007). The Use of Essential Oils in Ruminants as Modifiers of Rumen Microbial Fermentation. Penn State Dairy Cattle Nutrition Workshop.

Camejo-Rodrigues, J. S., Ascensão, L., Bone, T. M. A. and Vallès, J. (2003). An ethnobotanical study of medicinal and aromatic plants in the Natural Park of Serra de S. Mamede (Portugal*). J. Ethnopharmacol*., **89**: 199"209.

Cantore, P.L., N.S. Iacobellis, A.D. Marco, F. Capasso and F. Senatore. (2004). Antibacterial Activity of *Coriandrum sativum* L. and *Foeniculum vulgare* Miller Var. vulgare (Miller) Essential Oils. *J. Agric. Food Chem.,* **52**(26): 7862-7866s.

Chandra, S., Oberoi, P. S., Singh, P. K., Barjibhe, S., Kumar, A., Bhakat, M, Kumar, N and Dang, A. K. (2016). Effect of Poly-herbal mixture and butyric acid feeding on immune parameters of postpartum Murrah buffaloes. *Indian Journal of Animal Research*, (OF).

Chang, C., Griffith, G., and Maino, G. (2011). The feasibility of fresh ginger exports from Papua New Guinea to New Zealand. *Australasian Agribusiness Review*, **19**, 75-97.

Chauhan. B., Kumar, G. and Ali, M. (2012) A Review on phytochemical constituents and activities of *Trachyspermum ammi* (L.) sprague fruits. *AJPTR.* **2**(4):329–40.

Choi, E. M. and Hwang, J. K. (2004). Anti-inflammatory, analgesic and antioxidant activities of the fruit of Foeniculum vulgare. *Fitoterapia*, **75**: 557-565.

Choi, W., Jiang, M. and Chu, J. (2013). Antiparasitic effects of *Zingiber officinale* (Ginger) extract against Toxoplasma gondii. *Journal of Applied Biomedicine*, **11**(1), 15-26.

Choudhury, S., Ahmed, R., Kanjilal, P. B. and Leclercq, P. A. (1998). Composition of the seed oil of *Trachyspermum ammi* (L.) Sprague from Northeast India. *J Essent Oil Res: JEOR.* **10**(5):588–90.

Dadalioglu, I. and Evrendilek, G. A. (2004). Chemical compositions and antibacterial effects of essential oils of Turkish oregano (*Origanum minutiflorum*), bay laurel (*Laurus nobilis*), Spanish lavender (*Lavandula stoechas* L.), and fennel (*Foeniculum vulgare*) on common food borne pathogens. *J. Agri. and Food Chem*., **52**: 8255-8260.

Defrain, J. M., Hippen, A. R., Kalscheur, K. F. and Patton, R. S. (2005). Effect of Feeding ropionate and Calcium Salts of Long-Chain Fatty Acids on Transition Dairy Cow Performance. *J. Dai. Sci*., **88**:983-993.

Denyer, C. V., Jackson, P., Loakes, D. M., Ellis, M. R. and Young, D. A. (1994). Isolation of antirhinoviral sesquiterpenes from ginger (*Zingiber officinale). Journal of Natural Products,* **57**(5), 658-662.

Dodds, E. C., Goldberg, L., Lawson, W. and Robinson, R. (1938). Oestrogenic activity of certain synthetic compounds. *Nature*, **141**(3562), 247-8.1938).

Elgayyar, M., Draughon, F.A. and Golden, D.A. (2001). Antimicrobial activity of essential oils from plants against selected pathogenic and saprophytic microorganisms. *J Food Prot*., *64*(7):1019-1024. 11456186.

El-Soud, N. A., El-Laithy, N., El-Saeed, G., Wahby, M. S., Khalil, M. and Morsy, F. (2011). Antidiabetic activities of *Foeniculum vulgare* Mill. Essential oil in streptozotocin induced diabetic rats. *Macedonian J. Med. Sci.*, **173**: 1857-5773.

Erdogan Orhan, I., and Tareq Hassan Khan, M. (2014). Flavonoid derivatives as potent tyrosinase inhibitors–A survey of recent findings between 2008-2013. *Current topics in Medicinal Chemistry*, *14*(12), 1486-1493.

Faudale M, Viladomat F, Bastida J, Poli F, Codina C (2008). Antioxidant activity and phenolic composition of wild, edible, and medicinal fennel from different Mediterranean countries. *J. Agric. Food Chem*. **56**: 1912-1920.

Ficker, C. E., Arnason, J. T., Vindas, P. S., Alvarez, L. P., Akpagana, K., Gbeassor, M., ... and Smith, M. L. (2003). Inhibition of human pathogenic fungi by ethnobotanically selected plant extracts. *Mycoses*, **46**(1 2), 29-37.

Fox, I. J., Chowdhury, J. R., Kaufman, S. S., Goertzen, T. C., Chowdhury, N. R., that. (1998). Treatment of the Crigler–Najjar syndrome type I with hepatocyte transplantation. *New England Journal of Medicine*, **338**(20), 1422-1427.

Goff, J.P. (2000). Matitis and retained placenta relationship to bovine immunology and nutrition. USDA, Metabolic Diseases and Immunology Research Unit, Ames, IA5001-0-070, USA.

Goff, J.P. (2006). Major advances in our understanding of nutritional influences on bovine health. *J. Dairy Sci*. **89:** 1292-1301.

Govindarajan V. S. (1982). Ginger Fchemistry, technology and quality evaluation: part 2. CRC Crit Rev Sci Nutr; 17: 189–258.

Grummer, R. R. (1995). Impact of changes in organic nutrient metabolism on feeding the transition dairy cow. *Indian J. Dai. Sci.,* **73**(9), 2820-2833.

Grzanna, R., Lindmark, L., and Frondoza, C. G. (2005). Ginger—an herbal medicinal product with broad anti-inflammatory actions. *Journal of medicinal food*, **8** (2), 125-132.

Han, M.-K., Kim, S.I. and Ahn, Y.-J. (2006). Insecticidal and antifeedant activities of medicinal plant extracts against Attagenus unicolor japonicas (Coleoptera: Dermestidae). *J. Stored Prod. Res.,* **42**: 15–22.

Hare, H. A., Caspari, C. and Rusby, H. H. (1916). The National Standard Dispensatory, Lea and Febiger, Philadelphia, pp., 63 and 1129.

He, J. Z., Zhang, M. Z., and Wang, L. (2010). Zhongguo Zhong xi yi jie he za zhi Zhongguo Zhongxiyi jiehe zazhi= Chinese journal of integrated traditional and Western medicine. *Zhongguo Zhong xi yi jie he xue hui, Zhongguo Zhong yi yan jiu yuan zhu ban*, **30**(8), 797-801.

Heamalatha, S., Swarnalatha, S., Divya, M., Gandhi Lakshmi, R., Ganga Devi, A. and Gomathi, E. (2011). Pharmacognostical, pharmacological, investigation on *Anethum graveolens* Linn: A review. *Res. J. Pharmace. Biol. and Chem. Sci.,* **2**: 564-574.

Hosseinzadeh, H., Karimi, G. R. and Ameri, M. (2010). BMC pharmacology Volume: 2 ISSN: 1471-2210.

Ishikawa, T., Kudo, M., and Kitajima, J. (2002). Water-soluble constituents of dill. *Chemical and pharmaceutical bulletin*, **50** (4), 501-507.

Jagetia, G. C., Baliga, M. S., Venkatesh, P., and Ulloor, J. N. (2003). Influence of ginger rhizome (*Zingiber officinale*) on survival, glutathione and lipid peroxidation in mice after whole-body exposure to gamma radiation. *Radiation Research*, **160** (5), 584-592.

Jana, S., and Shekhawat, G. S. (2010). In vitro Extracts of Indian Medicinal Herb: Anethum grave-olefins.

Jayaweera, D.M.A. (1981). Medicinal Plant: Part III. Peradeniya, Royal Botanic Garden, Sri Lanka: p. 255.

Jiang, H., Xie, Z., Koo, H. J., McLaughlin, S. P., Timmermann, B. N. and Gang, D. R. (2006). Metabolic profiling and phylogenetic analysis of medicinal Zingiber species: Tools for authentication of ginger (*Zingiber officinale*). *Phytochemistry*, **67** (15), 1673-1685.

Kaur, G. J., and Arora, D. S. (2010). Bioactive potential of Anethum graveolens, *Foeniculum vulgare* and *Trachyspermum ammi* belonging to the family Umbelliferae-Current status. *Journal of Medicinal Plants Research*, **4** (2), 087-094.

Kaushik, P., Goyal, P., Chauhan, A. and Chauhan, G. (2010). In vitro evaluation of antibacterial potential of dry fruit extracts of *Elettaria cardamomum* Maton (Chhoti Elaichi). *Iranian Journal of Pharmaceutical Research*, 287-292.

Kaviarasan, S., Naik, G.H., Gangabhagirathi, R., Anuradha, C.V. and Priyadarsini, K.I. (2007). In vitro studies on antiradical and antioxidant activities of fenugreek (*Trigonella foenum graecum*) seeds. *Food Chem.*, **103**: 31–37.

Kehrli, M. E., Neill, J. D., Burvenich, C., Goff, J. P., Lippolis, J. D., Reinhardt, T. A. and Nonnecke, B. J. (2006). Energy and protein effects on the immune system. *Ruminant physiology. Digestion, metabolism and impact of nutrition on gene expression, immunology and stress*, 455-471.

Krishnamoorthy, V. (1999). Madalageri MB. Bishop weeds (Trachyspermum ammi): An essential crop for north Karnataka. *Journal of Medicinal and Aromatic Plant Sciences*, **21** (4), 996-998.

Lee, H. S. (2004). Acaricidal activity of constituents identified in *Foeniculum vulgare* fruit oil against Dermatophagoides spp.(Acari: Pyroglyphidae). *Journal of agricultural and food chemistry*, **52** (10), 2887-2889.

Madar, Z. and Arad, J. (1989). Effect of extracted fenugreek on postprandial glucose levels in human diabetic subjects. Nutr. Res., 9: 691–692.

Madar, Z., Abel, R., Samish, S. and Arad, J. (1988). Glucose- lowering effect of fenugreek in non-insulin dependent diabetics. *European J. Clin. Nutr*. **42**: 51–54.

Mahady GB, Pendland SL and Stoia A, Hamill FA, Fabricant D, Dietz BM, Chadwick LR (2005) *In vitro* susceptibility of Helicobacter pylori to botanical extracts used traditionally for the treatment of gastro- Kaur intestinal disorders. Phytother. Res. 19: 988-991.

Majdalawieh, A. F., and Carr, R. I. (2010). In vitro investigation of the potential immunomodulatory and anti-cancer activities of black pepper (Piper nigrum) and cardamom (*Elettaria cardamomum*). *Journal of Medicinal Food*, **13**(2), 371-381.

Manzoor, M., R. Jabeen, S. Irfan, F. Ayub and S. Bibi. (2012). An Ethno botanical Study for the Treatment of Cancer and Malaria Used by the People of Quetta City. *Int. J. Basic App. Chem. Sci.,* **1** (2): 137-149.

Minija J, Thoppil JE (2002) Essential oil composition of *Trachyspermum ammi* (L.) Sprague from south India. *Indian J Pharm Sc*i **64**(3):250–251.

Moazeni, M., Saharkhiz, M. J. and Hosseini, A. A. (2012). In vitro lethal effect of ajowan (*Trachyspermum ammi* L.) essential oil on hydatid cyst protoscoleces. *Veterinary parasitology*, **187**(1), 203-208.

Mohsenzadeh M (2007). Evaluation of antibacterial activity of selected Iranian essential oils against Staphylococcus aureus and Escherichia coli in nutrient broth medium. *Pak. J. Biol. Sci*. **10**:3693-3697.

Nair S, Nagar R. and Gupta, R. (1998). Antioxidant phenolics and flavonoids in common Indian foods. *J. Assoc Physicians India*; **46**(8):708-710.

Natrajan, B., Muralidharan, A., Satish, R. and Dhananjayan, R. (2007). Neuropharmacologicial activity of *Trigonella foenum-graecum* Linn. *Seeds. J. Nat. Rem*., **7**: 160–165.

Ostad, S.N., Soodi, M., Shariffzadeh, M., Khorshidi, N. and Marzban, H. (2001). The effect of fennel essential oil on uterine contraction as a model for dysmenorrhea, pharmacology and toxicology study. *J. Ethnopharmaco*., **76**: 299–304.

Ozbek, H., _gras, U., Dülger, S., Bayram, H., Tuncer, I. and Öztürk, I. G. (2003). Hepatoprotective effect of *Foeniculum vulgare* essential oil. *Fitoterapia*, **74**: 317-319.

Parthasarathy, V. A., K. Kandinnan and V. Srinivasan (2008). "Fenugreek". Organic Spices. New India Publishing Agencies. p. 694.

Penna, S. C., Medeiros, M. V., Aimbire, F. S. C., Faria-Neto, H. C. C., Sertie, J. A. A. and Lopes-Martins, R. A. B. (2003). Anti-inflammatory effect of the hydralcoholic extracts of *Zingiber officinale* rhizomes on rat paws and skin edema. *Phytome*, **10**(5): 381-385.

Pliny, Natural History, Loeb Classical Library, Vol. VI, Harvard University Press, (1942), pp, 111 and 113.

Pradhan, M., Sribhuwaneswari, S., Karthikeyan, D., Minz, S., Sure, P. and Chandu, A. N. (2008). In-vitro cytoprotection activity of *Foeniculum vulgare* and *Helicteres isora* in cultured human blood lymphocytes and antitumour activity against B16F10 melanoma cell line. *Res. J. Phar. and Tech.*, **1**(14): 450-452.

Pruthi, JS. (1992). Spices and Condiments. National Book Trust. 4th ed. New Delhi.

Qian, D. S. and Liu, Z. S. (1992). Pharmacologic studies of antimotion sickness actions of ginger

Raghuram, T.C., Sharma, R.D., Sivakumar, B. and Sahay, B.K. (1994). Effect of fenugreek seeds on intravenous glucose disposition in non- insulin dependent diabetic patients. Phytotherapy Res., 8: 83–86.

Raj Kumar, R. (2004). Studies on estrus induction efficiency of certain medicinal plants and homeopathic drugs in anoestrus cows. M.V.sc. thesis submitted to IVRI, Deemed University, Izatnagar, U.P. and India.

Rather, M. A., Dar, B. A., Sofi, S. N., Bhat, B. A., and Qurishi, M. A. (2016). *Foeniculum vulgare*: A comprehensive review of its traditional use, phytochemistry, pharmacology, and safety. *Arabian Journal of Chemistry*, ***9***, S1574-S1583.

RaviKumar, P. and Anuradha, C.V. (1999). Effect of fenugreek seeds on blood lipid peroxidation and antioxidants in diabetic rats. Phytotherapy Res., 13 (3): 197-201.

Reynolds, E.F.J. (1982). Essential Oils and Aromatic Carminatives, Martindale, the Extra Pharmacopeia, 28th ed. Royal Pharmac.l Society, London, pp. 670-676.

Ribes, G., Sauvaire, Y., Baccou, J. C., Valette, G., Chenon, D., Trimble, E. R. and Loubatières-Mariani, M. M. (1984). Effects of fenugreek seeds on endocrine pancreatic secretions in dogs. *Annals of Nutrition and Metabolism*, **28**(1), 37-43.

Ruberto, G., Baratta, M. T., Deans, S. G. and Dorman, H. J. D. (2000). Antioxidant and antimicrobial activity of *Foeniculum vulgare* and Crithmum maritimum essential oils. *Planta Medica*, **66**: 687-693.

Salie, F., Eagles, P.F.K., Leng and H.M.J., (1996). Primary antimicrobial screening of four South African Asteraceae species. *J. Ethanopharmacol*. **52**, 27–33.

Sapra, B. Gupta, S. and Tiwary, A.K. (2000). Role of volatile oil pretreatment and skin cholesterol on permeation of ion-paired diclofenac sodium. *Indian J Exp Biol*., **38**(9):895-900.

Shani, J., Goldschmied, A., Joseph, B., Aharonson, Z. and Sulman, F.G. (1974). Hypoglycaemic effect of *Trigonella foenum graecum* and *Lupinus termis* (Leguminosae) seeds and their major alkaloids in alloxan-diabetic and normal rats. *Archives Inter. Pharmacody.Thera*., **210**: 27–37.

Sharma, R. D., Raghuram, T. C. and Rao, N. S. (1990). Effect of fenugreek seeds on blood glucose and serum lipids in type I diabetes. Eur J Clin Nutr, **44(**4), 301-6.

Sharma, R.D. (1986). Effect of fenugreek seed and leaves on blood glucose and serum insulin responses in human subject. *Nutr. Res*., **6**: 1353–1364.

Shirin, Adel P. R. and Jamuna Prakash (2010). Chemical composition and antioxidant properties of ginger root (*Zingiber officinale). Journal of Medicinal Plants Research,* **4** (24), pp. 2674-2679.

Shobana, S. and Naidu, K.A., (2000). Antioxidant activity of selected Indian spices. Prostagland. *Leukot. Essent. Fatty Acids* **62:** 107–110.

Shojaaddini M, Moharramipour S and Sahaf B. (2008). Fumigant toxicity of essential oil from Carum copticum against Indian meal moth, Plodia interpunctella. *J Plant Prot Res*. **48** (4):411–19.

Singh MP, Panda H (2005). Medicinal Herbs with Their Formulations Volume 1. Daya Publishing House, Delhi, India, pp 97-100, 408-410.

Singh, G., Kapoor, I. P. S., Singh, P., de Heluani, C. S., de Lampasona, M. P. and Catalan, C. A. (2008). Chemistry, antioxidant and antimicrobial investigations on essential oil and oleoresins of *Zingiber officinale*. *Food and Chemical Toxicology*, **46** (10), 3295-3302.

Singh, G., Kiran, S., Marimuthu, P., Isidorov, V. and Vinogorova, V. (2008). Antioxidant and antimicrobial activities of essential oil and various oleoresins of *Elettaria cardamomum* (seeds and pods*). Journal of the Science of Food and Agriculture*, **88** (2), 280-289.

Singh, G., Maurya, S., De Lampasona, M. P. and Catalan, C. (2006). Chemical constituents, antifungal and antioxidative potential of *Foeniculum vulgare* volatile oil and its acetone extract. *Food control*, **17** (9): 745-752.

Sordillo, L.M. (2005). Factors affecting mammary glad immunity and mastitis susceptibility. *Liv. Prod. Sci*. **80:**1851-1865.

Stoilova, I., Krastanov, A., Stoyanova, A., Denev, P. and Gargova, S. (2007). Antioxidant activity of a ginger extracts (*Zingiber officinale*). *Food chemistry*, **102** (3), 764-770.

Suneetha, W.J. and Krishnakantha, T.P. (2005). Cardamom extract as inhibitor of human platelet aggregation. *Phytother Res*., **19** (5):437-440.

Sur, P., Das, M., Gomes, A., Vedasiromoni, J.R., Sahu, N.P., Banerjee, S., Sharma, R.M. and Ganguly, D.K., (2001). *Trigonella foenum-graecum* (fenugreek) seed extract as an antineoplastic agent. *Phytother. Res*., **15**: 257–259.

Taranalli, A.D. and Kuppast, I.J. (1996). Study of wound healing activity of seeds of *Trigonella foenum-graecum* in rats. *Ind. J. Pharm. Sci*., **58**: 117–119.

Thomas JE, Bandara M, Lee EL, Driedger D and Acharya S (2011) Biochemical monitoring in fenugreek to develop functional food and medicinal plant variants. *N Biotechnol* **28**: 110-117.

Thomson, M., Al-Qattan, K. K., Al-Sawan, S. M., Alnaqeeb, M. A., Khan, I. and Ali, M. (2002). The use of ginger (*Zingiber officinale*) as a potential anti-inflammatory and antithrombotic agent. Prostaglandins, leukotrienes and essential fatty acids, 67(6), 475-478.

Tognolini, M., Ballabeni, V., Bertoni, S., Bruni, R., Impicciatore, M. and Barocelli, E. (2007). Protective effect of *Foeniculum vulgare* essential oil and anethole in an experimental model of thrombosis. *Pharmacol. Res.,* **56**: 254–260.

Ugulu, I., Baslar, S., Yorek, N. and Dogan, Y. (2009). The investiga tion and quantitative ethnobotanical evaluation of medicinal plants used around Izmir province, Turkey. *J. Med. Plants Res*., **3**(5): 345-367.

Vaghasiya, M.P. (2001). Retention of placenta**.** *Honey Bee,* **12**: 26.

Wen-Rui Diao, Qing-Ping Hua, Hong Zhang, Jian-Guo Xu. (2014). Chemical composition, antibacterial activity and mechanism of action of essential oil from seeds of fennel (*Foeniculum vulgare* Mill). *Food Control*, **35**: 109-116.

Zaman, M. A., Iqbal, Z., Abbas, R. Z., Khan, M. N., Muhammad, G., Younus, M. and Ahmed, S. (2012). In vitro and in vivo acaricidal activity of a herbal extract. *Veterinary Parasitology*, **186** (3), 431-436.