THERAPEUTICS
NPARR, 6(3 & 4), 2015-207 Pharmacological basis for the medicinal use of Carissa carandas in constipation and diarrhea

Carissa carandas Linn. commonly known as “Karaunda” (Apocynaceae) is a popular medicinal herb widely distributed in different parts of Pakistan. In addition to other medicinal uses, Carissa carandas is popular in indigenous system of medicine for its medicinal use in gut motility disorders like, constipation and diarrhoea. This study was planned to provide pharmacological basis to the medicinal use of Carissa carandas in constipation and diarrhoea. The crude extract of the leaves of Carissa carandas (Cc.Cr) was prepared in methanol and its fractionation was carried out with ethylacetate, petroleum ether and n-butanol. In-vivo studies were conducted on mice, while isolated rabbit jejunum and guinea-pig ileum preparations were used for the in-vitro experiments. The spasmogenic and spasmodolytic responses of gut tissues were recorded using isotonic transducers coupled with PowerLab data acquisition system. The HPLC fingerprints of Cc.Cr, its petroleum (Cc.Pef), ethylacetate (Cc.Eaf) and n-butanol (Cc.Baf) fractions showed the presence of oleanolic acid, ursolic acid, stigmasterol and β-sitosterol. Oral administration of Cc.Cr to mice increased fecal output at lower doses (30 and 50 mg/kg), while it showed protection against castor oil-induced diarrhea at higher doses (300 and 600 mg/kg). In isolated guinea-pig ileum and rabbit jejunum, Cc.Cr and Cc.Baf exhibited stimulatory effect at 0.003–3 mg/ml, which was partially sensitive to atropine or pyrillamine or partially/fully sensitive to atropine+pyrillamine, followed by relaxation at higher tested concentrations, being more potent in rabbit tissues. The ethylacetate fraction (0.1–5 mg/ml) exhibited fully atropine-sensitive contractions in both guinea-pig and rabbit tissues, being more potent in guinea-pig while more efficacious in rabbit tissues. However, the petroleum fraction (0.003–1.0 mg/ml) showed only spasmodolytic activity in spontaneously contracting rabbit tissues, similar to nifedipine. In guinea-tissue, Cc.Pef did not cause any stimulant effect. When studied against high K⁺ (80 mM)-induced contraction, the crude extract and its fractions caused a dose-dependent inhibition, with the following order of potency: Cc.Pef>Cc.Eaf>Cc.Cr≥Cc.Baf, similar to nifedipine indicating Ca²⁺ channel antagonist like activity, which was further confirmed when the plant extract displaced Ca²⁺ curves to the right with suppression of maximum effect similar to that of nifedipine.

This study demonstrates that the crude extract of Carissa carandas possesses a gut-stimulatory effect mediated primarily through the activation of muscarinic and histaminergic receptors while its spasmodolytic effect was mediated possibly through Ca²⁺ antagonist pathway. Thus, this study provides a clear evidence for the dual effectiveness of Carissa carandas in constipation and diarrhoea, thus validating its medicinal use [Malik Hassan Mehmood, Nfn Anila, Sabira Begum, Saqib A. Syed, Bina S. Siddiqui and Anwarul-Hassan Gilani*(Natural Product Research Division, Department of Biological and Biomedical Sciences, The Aga Khan University Medical College, Karachi 74800, Pakistan), Journal of Ethnopharmacology, 2014, 153 (2), 359–367].

NPARR, 6(3 & 4), 2015-208 Pharmacological basis for the medicinal use of Linum usitatissimum (Flaxseed) in infectious and non-infectious diarrhea

Linum usitatissimum, commonly known as Flaxseed has traditionally been used for the management of diarrhea and gastrointestinal infections. This study was planned to assess pharmacological basis for the medicinal use of Flaxseed in infectious and non-infectious diarrhea. The crude aqueous-methanolic extract of Flaxseed was studied using the in vivo castor oil-induced diarrhea, gut motility and enteropooling assays. Mechanistic basis was further elucidated by testing
the inhibitory effect on spontaneously contracting isolated rabbit jejunum preparations, suspended in a 10 ml tissue bath containing Tyrode solution, maintained at 37 °C and aerated with carbogen. Antibacterial efficacy of the Flaxseed extract was tested against different enteric and non-enteric pathogenic bacteria using in vitro antibacterial assays. Flaxseed extract reduced the diarrheal score in mice, by 39%, 63.90% and 68.34% at the respective doses of 100, 300 and 500 mg/kg. Intestinal secretions were reduced by 24.12%, 28.09% and 38.80%, whereas the intestinal motility was reduced by 31.66%, 46.98% and 56.20% at respective doses of 100, 300 and 500 mg/kg. When tested on isolated rabbit jejunum preparations, Flaxseed extract produced a dose-dependent inhibition of both spontaneous and high K+ (80 mM)-induced contractions, and shifted the concentration–response curves of Ca++ to the right with suppression of the maximum response, similar to that caused by verapamil. Flaxseed extract was found to possess bactericidal activity at the tested concentrations of 12.5 mg/ml, against vancomycin-resistant Enterococcus faecalis (100%), Escherichia coli K1 (88.88%), methicillin-resistant Staphylococcus aureus (98.76%), Bacillus cereus (92.64%), Pseudomonas aeruginosa (76.83%) and Salmonella typhi (26.91±3.35%). The concentration of 10 mg/ml showed bactericidal effects against all the aforementioned pathogens except Escherichia coli K1, whereas for Pseudomonas aeruginosa and Salmonella typhi, it was bacteriostatic at this concentration. The results indicated that Linum usitatissimum (Flaxseed) extract exhibits antidiarrheal and antisypsmatic activities by virtue of its antimotility and antisecretory effects which are mediated possibly through inhibition of Ca++ channels, though additional mechanism(s) cannot be ruled out. Flaxseed extract proved effective against both enteric and non-enteric pathogens causing diarrhea, thus ensuring wide coverage and rationalizing its medicinal use in both the infectious and non-infectious diarrhoea [Amber Hanif Palla, Naveed Ahmed Khan, Samra Bashir, Najeeb ur-Rehman, Junaid Iqbal and Anwarul-Hassan Gilani *(Department of Biological and Biomedical Sciences, The Aga Khan University Medical College, Karachi 74800, Pakistan), Journal of Ethnopharmacology, 2015, 160, 61–68].

NPARR, 6(3 & 4), 2015-209 Antidiarrheal and antioxidant activities of chamomile (Matricaria recutita L.) decoction extract in rats

Matricaria recutita L. (Chamomile) has been widely used in the Tunisian traditional medicine for the treatment of digestive system disorders. The present work aims to investigate the protective effects of chamomile decoction extract (CDE) against castor oil-induced diarrhea and oxidative stress in rats. The antidiarrheal activity was evaluated using castor oil-induced diarrhea method. In this respect, rats were divided into six groups: Control, Castor oil, Castor oil+Loperamide (LOP) and Castor oil+various doses of CDE. Animals were per orally (p.o.) pre-treated with CDE during 1 h and intoxicated for 2 or 4 h by acute oral administration of castor oil.

The results showed that CDE produced a significant dose-dependent protection against castor oil-induced diarrhea and intestinal fluid accumulation. On the other hand, we showed that diarrhea was accompanied by an oxidative stress status assessed by an increase of malondialdehyde (MDA) level and depletion of antioxidant enzyme activities as superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx). Castor oil also increased gastric and intestinal mucosa hydrogen peroxide (H₂O₂) and free iron levels. Importantly, we showed that chamomile pre-treatment abrogated all these biochemical alterations.

These findings suggested that chamomile extract had a potent antidiarrheal and antioxidant properties in rats confirming their use in traditional medicine [Hichem Sebai, Mohamed-Amine Jabri, Abdelaziz Souli, Kais Ribi, Slimen Selmi, Olfa Tebourbi, Jamel El-Benna, Mohsen Sakly (Laboratoire de Physiologie Intégrée, Faculté des Sciences de Bizerte, 7021 Zarzouna, Tunisia), Journal of Ethnopharmacology, 2014, 152 (2), 327–332].
The goal for this study was to evaluate the effects of consumption of dried apple peel powder (DAPP) on joint function and range of motion (ROM). Additional in vitro and clinical testing was performed to suggest specific mechanisms of action. An open-label clinical pilot study involved 12 healthy people with moderate loss of joint ROM and associated chronic pain. The subjects consumed 4.25 g DAPP daily for 12 weeks, with evaluations at baseline, 2, 4, 8, and 12 weeks. ROM was evaluated at each visit using dual digital inclinometry. Pain scores were collected using Visual Analogue Scales. Blood draws enabled testing of serum antioxidant protective capacity using the cellular antioxidant protection (CAP-e) bioassay. Additional in vitro testing involved testing of cyclooxygenase-2 (COX-2) and lipoxygenase inhibition, cellular antioxidant protection by the CAP-e bioassay, and formation of reactive oxygen species (ROS) by polymorphonuclear (PMN) cells by flow cytometry. Twelve weeks of consumption of DAPP was associated with improved ROM. DAPP provided antioxidants that were available to enter into and protect cells from oxidative damage in vitro, and consumption of DAPP for 12 weeks was associated with a statistically significant improvement in serum antioxidant protective status. DAPP inhibited both COX-2 and lipoxygenase enzymes, and pretreatment of inflammatory PMN cells with DAPP before inflammatory stimulus resulted in reduced ROS formation. This suggests multifaceted anti-inflammatory properties of DAPP. Consumption of DAPP was associated with improved joint function and improved serum antioxidant protection status. The observed pain reduction may be associated with the improved antioxidant status and linked to the apple polyphenols' anti-inflammatory effects [Jensen Gitte S*, Attridge Victoria L., Benson Kathleen F., Beaman Joni L., Carter Steve G., and Ager David (NIS Labs, 1437 Esplanade, Klamath Falls, OR 97601, USA ), Journal of Medicinal Food, 2014, 17(11), 1204-1213].

Ultraviolet (UV) radiation causes photodamage to the skin, which, in turn, leads to depletion of the dermal extracellular matrix and chronic alterations in skin structure. Skin wrinkles are associated with collagen synthesis and matrix metalloproteinase-1 (MMP-1) activity. Coriandrum sativum L. (coriander leaf, cilantro; CS) has been used as a herbal medicine for the treatment of diabetes, hyperlipidemia, liver disease, and cancer. In this study, we examined whether CS ethanol extract (CSE) has protective effects against UVB-induced skin photoaging in normal human dermal fibroblasts (NHDF) in vitro and in the skin of hairless mice in vivo. The main component of CSE, linolenic acid, was determined by gas chromatography-mass spectroscopy. We measured the cellular levels of procollagen type I and MMP-1 using ELISA in NHDF cells after UVB irradiation. NHDF cells that were treated with CSE after UVB irradiation exhibited higher procollagen type I production and lower levels of MMP-1 than untreated cells. We found that the activity of transcription factor activator protein-1 (AP-1) was also inhibited by CSE treatment. We measured the epidermal thickness, dermal collagen fiber density, and procollagen type I and MMP-1 levels in photo-aged mouse skin in vivo using histological staining and western blot analysis. Our results showed that CSE-treated mice had thinner epidermal layers and denser dermal collagen fibers than untreated mice. On a molecular level, it was further confirmed that CSE-treated mice had lower MMP-1 levels and higher procollagen type I levels than untreated mice. Our results support the potential of C. sativum L. to prevent skin photoaging [Hwang Eunson, Lee Do-Gyeong, Park Sin Hee, Oh Myung Sook, and Kim Sun Yeou (College of Pharmacy,
Cancer is a leading cause of death and is responsible for one in eight deaths worldwide. The use of herbs as complementary medicine for cancer, especially advanced cancer, has recently increased. The aim of this study was to evaluate in vitro, the antiproliferative effect of *Origanum vulgare* against human breast adenocarcinoma (MCF-7), and human colon adenocarcinoma (HT-29). The essential oil (EO) was extracted from a bought amount of *O. vulgare* dried leaves and analyzed in a gas chromatograph interfaced with a mass selective detector. The cytotoxicity test was performed by sulforhodamine B assay. The results show that the EO is composed mostly of 4-terpineol and induces a high cytotoxicity effect in HT-29. In the MCF-7 cell line the EO was less effective. In conclusion, this study showed that *O. vulgare* main component is 4-terpineol and was effective in inducing cancer cell growth inhibition [Karine Rech Begnini, Fernanda Nedel, Rafael Guerra Lund*, Pedro Henrique de Azambuja Carvalho, Maria Regina Alves Rodrigues, Fátima Tereza Alves Beira, and Francisco Augusto Burkert Del-Pino (Dentistry, Pelotas Dental School, Federal University of Pelotas (UFPeI), Gonçalves Chaves St., 457/503, Pelotas 96015-560, RS, Brazil), *Journal of Medicinal Food*, 2014, 17(10), 1129-1133].

*NPARR*, 6(3 & 4), 2015-213 **Sorghum [Sorghum bicolor (L.) Moench] leaf sheath dye protects against cisplatin-induced hepatotoxicity and oxidative stress in rats**

This study sought to determine the protective effect of dietary inclusion of sorghum leaf sheath dye on cisplatin-induced hepatotoxicity and oxidative stress in rats. Adult male rats were randomly divided into four groups with six animals in each group. Groups I and II were fed a basal diet, while groups III and IV were fed diets containing 0.5% and 1% sorghum leaf sheath dye, respectively, for 20 days before cisplatin administration. Hepatotoxicity was induced by a single dose of cisplatin (7 mg/kg body weight, i.p.), and the experiment was terminated at 3 days after cisplatin injection. The liver and plasma were studied for hepatotoxicity and antioxidant capacity. Cisplatin caused a significant (*P*<.05) alteration in plasma and liver enzymatic (catalase, glutathione-S-transferase [GST], and superoxide dismutase [SOD]) and nonenzymatic (glutathione [GSH] and vitamin C) antioxidant indices with a concomitant increase in the malondialdehyde (MDA) content; however, there was a significant (*P*<.05) restoration of the antioxidant status coupled with a significant (*P*<.05) decrease in the tissue MDA content, after consumption of diets containing sorghum leaf sheath dye. Furthermore, dietary inclusion of sorghum leaf sheath dye caused a marked reduction in the activities of alanine aminotransferase and aspartate aminotransferase after cisplatin administration. However, the ability of the dye to prevent significant cisplatin-induced alteration of both plasma and liver antioxidant indices suggests an antioxidant mechanism of action. Hence, this protective effect of *Sorghum bicolor* leaf sheath dye against cisplatin-induced hepatotoxicity in rats reflects its potential and beneficial role in the prevention of liver damage associated with cisplatin administration [Ademiluyi Adedayo O*, Oboh Ganiyu, Agbebi Oluwaseun J, Boligon Aline A, and Athayde Margareth L (Functional Foods, Nutraceuticals and Phytomedicine Unit, Department of Biochemistry, Federal University of Technology, Akure, PMB 704, Akure 340001, Nigeria), *Journal of Medicinal Food*, 2014, 17(12), 1332-1338].

*NPARR*, 6(3 & 4), 2015-214 **TRAMP Prostate tumor growth is slowed by walnut diets through altered igf-1 levels, energy pathways, and cholesterol metabolism**

Dietary changes could potentially reduce prostate cancer morbidity and mortality. Transgenic
adenocarcinoma of the mouse prostate (TRAMP) prostate tumor responses to a 100 g of fat/kg diet (whole walnuts, walnut oil, and other oils; balanced for macronutrients, tocopherols [α- and γ]) for 18 weeks ad libitum were assessed. TRAMP mice (n=17 per group) were fed diets with 100 g fat from either whole walnuts (diet group WW), walnut-like fat (diet group WLF, oils blended to match walnut's fatty acid profile), or as walnut oil (diet group WO, pressed from the same walnuts as WW). Fasted plasma glucose was from tail vein blood, blood was obtained by cardiac puncture, and plasma stored frozen until analysis. Prostate (genitourinary intact [GUI]) was weighed and stored frozen at −80°C. Plasma triglyceride, lipoprotein cholesterol, plasma multianalyte levels (Myriad RBM Rat Metabolic MAP), prostate (GUI), tissue metabolites (Metabolon, Inc., Durham, NC, USA), and mRNA (by Illumina NGS) were determined. The prostate tumor size, plasma insulin-like growth factor-1 (IGF-1), high density lipoprotein, and total cholesterol all decreased significantly (P<0.05) in both WW and WO compared to WLF. Both WW and WO versus WLF showed increased insulin sensitivity (Homeostasis Model Assessment [HOMA]), and tissue metabolomics found reduced glucose-6-phosphate, succinylcarnitine, and 4-hydroxybutyrate in these groups suggesting effects on cellular energy status. Tissue mRNA levels also showed changes suggestive of altered glucose metabolism with WW and WO diet groups having increased PCK1 and CIDEC mRNA expression, known for their roles in gluconeogenesis and increased insulin sensitivity, respectively. WW and WO group tissues also had increased MSMB mRNA a tumor suppressor and decreased COX-2 mRNA, both reported to inhibit prostate tumor growth. Walnuts reduced prostate tumor growth by affecting energy metabolism along with decreased plasma IGF-1 and cholesterol. These effects are not due to the walnut's N-3 fatty acids, but due to component(s) found in the walnut's fat component [Kim Hyunsook, Yokoyama Wallace and Davis Paul Andrew* (Paul Andrew Davis, PhD, Department of Nutrition, University of California, Davis, Davis, CA 95616, USA), Journal of Medicinal Food, 2014, 17(12), 1281-1286].

NPARR, 6(3 & 4), 2015-215 Chemical composition and antibacterial activity of foliage and resin essential oils of Araucaria cunninghamii Aiton ex D.Don and Araucaria heterophylla (Salisb.) Franco from India

The essential oils of foliage and resin of Araucaria cunninghamii Aiton ex D. Don and Araucaria heterophylla (Salisb.) Franco were isolated by hydrodistillation and subsequently analyzed using gas chromatography (GC/FID) and GC–mass spectrometry (GC/MS). Altogether 113 constituents, representing 84.0–97.6% of the total oil compositions were identified. Major constituents of the foliage oil of A. cunninghamii were beyerene (34.6–44.4%), caryophyllene oxide (0.5–17.9%), α-pinene (3.3–16.2%), germacrene D (0.1–9.8%), kaurene (1.7–5.1%), and 13-epi-dolabradiene (4.2–4.8%). However, the resin oil of A. cunninghamii was characterized by higher amounts of (E)-caryophyllene (60.8%), caryophyllene oxide (13.4%), and (E)-β-farnesene (4.9%). The foliage oil of A. heterophylla was dominated by 13-epi-dolabradiene (42.7%), beyerene (22.2%), rimuene (13.7%), and dolabradiene (3.9%), whereas the resin oil of A. heterophylla contained α-copaene (29.9%), germacrene D (21.4%), γ-gurjunene (9.7%), δ-cadinene (7.1%), and sandaracopimara-8(14),15-diene (6.5%) as main constituents. The foliage and resin essential oils of both species showed minimum inhibitory concentration (MIC) in the range of 250–500 µg/mL and minimum bactericidal concentration (MBC) in the range of 1000 to >1000 µg/mL against tested bacterial strains [Ram S. Verma*, Rajendra C. Padalia, Prakash Goswami, Sajendra K. Verma, Amit Chauhan, Mahendra P. Darokar (Department of Natural Product Chemistry, CSIR-Central Institute of Medicinal and Aromatic Plants, Research Centre-Pantnagar, P.O. Dairy Farm
Phytochemical, antioxidant, antibacterial, and \( \alpha \)-amylase inhibitory properties of different extracts from betel leaves

Antimicrobial and antioxidant activities, phenol content, and \( \alpha \)-amylase inhibitory effects of a local variety of betel leaves were evaluated. The effects of various solvents (methanol, ethanol, acetone, and ethyl acetate) on phenols and antioxidant activities were also studied. Methanol and ethanol (90%) extracts showed maximum phenolic contents (205.2 and 202.9 mg GAE/g, respectively). Maximum flavonoid contents were determined using 90% acetone (82.5 mg CE/g), and the highest inhibition percentage of 2,2-diphenyl-1-picrylhydrazyl radical was exhibited by 90% ethanol (percent inhibition, 94%). \( \alpha \)-Amylase activity assay showed that \( \alpha \)-amylase inhibitory activities were positively correlated with the total phenolic content of ethanol and methanol. Considering antimicrobial activities, we found that all of the Gram-positive bacteria and Gram-negative bacteria were inhibited by betel leaf extract except \textit{Pseudomonas aeruginosa}. Our results could provide a basis of future studies on betel leaves used in food and pharmaceutical applications [Leila Nouri and Abdorreza Mohammadi Nafchi* (Food Biopolymer Research Group, Food Science and Technology Department, Damghan Branch, Islamic Azad University, Damghan, Semnan, Iran), \textit{Industrial Crops and Products}, 2014, 62, 47–52].

In vitro antimutagenic activity of \textit{Vitex agnus-castus} L. essential oils and ethanolic extracts

This study investigated the antimutagenic activity of the essential oil of the leaves and the ethanolic extract of the seeds of \textit{Vitex agnus-castus}, a common plant with both medicinal and economic value. Ames \textit{Salmonella}/microsome mutagenicity tests showed the essential oil of \textit{V. agnus-castus} leaves at 0.125, 0.0125, and 0.00125 mg/plate concentrations and the ethanolic extract of \textit{V. agnus-castus} seeds at 2.5, 0.25, and 0.025 mg/plate concentrations to have antimutagenic effects on \textit{Salmonella typhimurium} TA98 and TA100. Moreover, neither the essential oils nor the ethanolic extracts exhibited any mutagenic activity themselves. To our knowledge, this is the first study to be conducted on the antimutagenic activities of \textit{V. agnus-castus} essential oils and extracts and provides important data for the fields of medicine and pharmaceuticals [Nurdan Sarac*, Aysel Ugur and Burak Sen (Medical Laboratory Programme, Vocational School of Health Sciences, Mugla Sitki Kocman University, Mugla, Turkey), \textit{Industrial Crops and Products}, 2015, 63, 100–103].

Biosynthesis, characterization and antibacterial effect of plant-mediated silver nanoparticles using \textit{Ceropegia thwaitesii} – An endemic species

Leaf extract of \textit{in vitro} raised plants of \textit{Ceropegia thwaitesii} was assessed for the green synthesis of silver nanoparticles (AgNPs). The biosynthesized AgNPs were authorized by UV–vis spectrophotometer with surface plasmon resonance at 430 nm. The scanning electron microscope (SEM), dynamic light scattering (DLS) analysis confirmed the particle size 100 nm, and X-ray diffraction (XRD) confirmed the crystalline character of AgNPs. Further, Fourier transform infrared (FTIR) authorized the presence of triterpenoids and methoxy groups played an important reduction role in the synthesis process. It shows the significant antibacterial efficacy against \textit{Salmonella typhi}, \textit{Shigella flexneri}, \textit{Klbsiella pneumonia}, \textit{Eschericia coli} and others species. From the results, it is suggested that green synthesized AgNPs could be used effectively in future
biomedical engineering [S. Muthukrishnan, S. Bhakya\textsuperscript{a}, T. Senthil Kumar\textsuperscript{*} and M.V. Rao\textsuperscript{a} (Department of Industry University Collaboration, Bharathidasan University, Tiruchirappalli 620 024, Tamil Nadu, India), \textit{Industrial Crops and Products}, 2015, \textbf{63}, 119-124].

\textit{NPARR}, 6(3 & 4), 2015-219 \textbf{Antibacterial activity of spathe from \textit{Phoenix dactylifera} L. against some food-borne pathogens}

The study aimed to evaluate the in vitro antibacterial activity of extracts from spathe (date palm) against \textit{Listeria monocytogenes} ATCC 7644, \textit{Staphylococcus aureus} (ATCC 25923 and 29213), \textit{Staphylococcus saprophyticus} ATCC 15305, \textit{Salmonella enterica} subsp. \textit{enterica} ATCC 13076, \textit{Escherichia coli} ATCC 25922, and \textit{Pseudomonas aeruginosa} ATCC 27853. Results of the agar diffusion assay indicated that the 80\% methanolic extract of spathe (ME) was the most active sample against test pathogens, compared to water or petroleum ether extracts. The inhibition zones produced by ME were 11–31 mm against the test bacteria. Minimum inhibitory concentration (MIC), determined by the agar dilution method of ME against gram positive bacteria was 1.5 mg/ml. MIC of ME for gram negative bacteria was 3 mg/ml. Preliminary phytochemical tests revealed that ME contained phenolics and flavonoids. The Folin–Ciocalteu method showed that total phenolics (265.7 mg Gallic acid equivalent/g) were significantly ($P < 0.05$) higher in ME than other extracts. Total antioxidant capacity (phosphomolybdenum method) of ME was 530 \textmu g ascorbic acid equivalent/g. It could be summarized that spathe contains active phytochemicals which may find applications in the food industry and pharmaceuticals [Najeeb S. Al-zoreky\textsuperscript{*} and dulla Y. Al–Taher ( Department of Food and Nutrition Science, College of Agricultural and Food Sciences, King Faisal University, P.O. Box 400, Al-Ahsa 31982, Saudi Arabia), \textit{Industrial Crops and Products}, 2015, \textbf{65}, 241–246].

\textit{NPARR}, 6(3 & 4), 2015-220 \textbf{Lawsonia inermis L. – A commercially important primaeval dying and medicinal plant with diverse pharmacological activity: A review}

\textit{Lawsonia inermis}, popularly known as Henna or Mehndi in the Oriental world, is an evergreen medium sized shrub of the Family Lythraceae. The leaf paste of this plant has been traditionally used for dying hair, skin and nails since antiquity. Besides cosmaceutical usages, the plant also harbours a well-documented folklore history for treating convulsion, jaundice and malignant ulcers. Phytochemical studies in henna plant have indicated the presence of several bioactive molecules like isoplumagin, lupeol, 30-norlupan-3-ol-20-one, betuhennan, betuhennanic acid and n-tridecanoate phenolic glucosides, lawsoniaside, $\beta$-sitosterol and stigmasterol in leaves and roots. Lawson (2-hydroxy-1,4-naphthoquinone), the red orange dye present in the henna leaf paste, is being used in modern pharmacopoeia as a starting molecule for the synthesis of clinically important anticancer drugs such as atovaquone, lapachol and dichloroallyl lawson. Pharmacological prospection of \textit{L. inermis} plant extracts in last two decades have indicated strong nootropic, CNS depressing, antimicrobial, antioxidant, wound healing, anti-inflammatory, antipyretic, analgesic, hepatoprotective, tuberculostatic, diuretic, hypoglycemic and antiparasitic actions. An attempt has been made in this review to accentuate a comprehensive literature up-date on pharmacological investigations carried out in \textit{L. inermis}. To the best of our knowledge and belief this is the first compilation in this direction in Henna [Dhananjay Kumar Singh, Suaib Luqman\textsuperscript{*} and Ajay Kumar Mathur (Molecular Bioprospекtion Department of Biotechnology Division, CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow 226015, India), \textit{Industrial Crops and Products}, 2015, \textbf{65}, 269–286].
The present study was conducted to elucidate the composition, antifungal and anti-inflammatory activities and cytotoxicity of *Daucus carota* subsp. *gummifer* essential oil. Aerial parts of the plants were hydrodistilled and the oil analyzed by GC and GC–MS. The oil was characterized by high contents of monoterpenes (83.9%), the major compounds being geranyl acetate (37.0%) and α-pinene (30.9%). The daucane sesquiterpene, carotol, was also found in relatively high amounts (11.0%). For the antifungal activity, minimal inhibitory and minimal lethal concentrations (MIC and MLC, respectively) were determined against several pathogenic fungi strains. The oil was particularly active against dermatophytes and *Cryptococcus neoformans*, with MIC values ranging from 0.32 to 0.64 µL/mL. Concerning the anti-inflammatory potential, the oil demonstrated a strong anti-inflammatory activity by inhibiting nitric oxide (NO) production in both lipopolysaccharide (LPS)-triggered macrophages and microglia cells. NO scavenging activity was also assessed using the NO donor S-nitroso-N-acetyl-d,l-penicillamine and a significant effect was disclosed. To assure that the bioactivity of the oil was achieved without detrimental effects to cells, the toxicity of *D. carota* subsp. *gummifer* oil was investigated using the MTT assay in several mammalian cell lines: macrophages (Raw 264.7), keratinocytes (HaCat), hepatocytes (HepG2) and microglia (N9). Interestingly, we detected a cytotoxic effect only for the highest concentrations of the oil, thus assuring a safe toxicological profile at bioactive concentrations.

These results advise that *D. carota* subsp. *gummifer* essential oil should be explored as a natural source of antifungal and anti-inflammatory drugs with potential application both at the peripheral and central nervous system levels, thus supporting in vivo studies focused in the management of dermatophytosis and/or inflammatory-related diseases [J. Valente, M. Zuzarte, R. Resende, M.J. Gonçalves, C. Cavaleiro, C.F. Pereira, M.T. Cruz, L. Salgueiro*(Center of Pharmaceutical Studies, Health Science Campus, University of Coimbra, Azinhaga de S. Comba, 3000-354 Coimbra, Portugal), *Industrial Crops and Products*, 2015, 65, 361–366].