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Ogwiji Matthew
Department of Animal Science and Range Management, Faculty of Agriculture, Modibbo Adama University Yola, Adamawa State, Nigeria

Ajao Olubunmi Folake
Department of Crop Protection, Faculty of Agriculture, Modibbo Adama University Yola, Adamawa State, Nigeria

Okwanya Musa Idu
Department of Biochemistry, Faculty of Life Science, Modibbo Adama University Yola, Adamawa State, Nigeria

Mbaya Yalma Philip
Department of Animal Science and Range Management, Faculty of Agriculture, Modibbo Adama University Yola, Adamawa State, Nigeria

Corresponding Author:
Ogwiji Matthew
Department of Animal Science and Range Management, Faculty of Agriculture, Modibbo Adama University Yola, Adamawa State, Nigeria

Beneficial activities of ethnobotanical plants on selected systems and agriculture

Ogwiji Matthew, Ajao Olubunmi Folake, Okwanya Musa Idu and Mbaya Yalma Philip

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Abstract
Recent scientific studies have focused heavily on the use of medicinal plants in agriculture and folkloric medicine as a complementary therapy, preventive strategy, or full therapy. Phytotherapy is being used more and more frequently for preventive purposes, the treatment of minor or chronic diseases, and recurrent infections, and for the advancement of organic livestock. In order to increase the activity of the immunological or reproductive systems and stimulate biochemical, haematological, or certain organ functions, extract preparations of several plants have been utilized. Many herbal metabolites have demonstrated antibacterial, antioxidant, reproductive enhancement and insecticidal properties. The most often utilized plants for health, reproduction, parasites, and insect pests' control were carefully reviewed in this article.

Keywords: Ethnobotanical, medicinal plants, fertility, insect pests, anthelminthic activity, antioxidant

1. Introduction
People relied on plants for the treatment and prevention of diseases in humans and animals before the invention of pharmaceutical medications and iatrochemistry in the sixteenth century (Dzoyem *et al*. 2020; Abera and Mulate 2019; Gakuubi, 2012; Kelly 2009) [39, 3, 47, 75]. In the beginning, the effectiveness of medicinal herbs was determined by instinct (Jamshidi-Kia *et al*. 2018; Pan *et al*. 2014) [69, 125s]. The earliest known instances of ethnomedical practice date to around 3000 BCE. Indian, Egyptian, Chinese, Greek, and Roman civilizations all showed the therapeutic value of medicinal plants by using them to treat a variety of illnesses as well as to energize their bodies (Pan *et al*. 2014) [125]. The use of medicinal plants has grown over time, particularly in light of the downsides of synthetic drugs and chemicals (Kumar *et al*. 2022; Suleiman *et al*. 2016) [83, 152], including the decline in their efficacy, resistance, and toxicity in addition to growing concerns over the presence of drug and chemical residues in animal products and agricultural practices that increased the health risks posed to consumers and the environment (Ramdani *et al*. 2023; Gainza *et al*. 2021; Archana, 2014) [134, 46, 13].
In Africa and other regions of the world, medicinal plants make up around 95% of all traditional medicine formulations (Ozioma and Okaka 2019; Gude 2013) [123, 56]. These plants are widely available in local communities and have long been trusted by resource-constrained farmers as a powerful source of healthcare with little adverse effects (Mensah *et al*. 2019; Saleh *et al*. 2015) [104, 140]. Many plants produce secondary metabolites, which have been shown to protect plants, animals, and humans from bacterial, fungal, parasite and insect activities (Manukumar *et al*. 2017; Ngulde *et al*. 2015) [99, 111]. They are also involved in the biochemical processes of growth and reproduction (Sadiq *et al*. 2018; Patra & Saxena 2009; Rochfort *et al*. 2008) [138, 127, 137]. Over the years, phytochemicals in plants have also provided an essential pathway for pharmaceutical advancement (Okhale *et al*. 2016) [117]. As a result, a review of these ethnobotanicals and their applications and effectiveness in phytotherapy needs periodic updating because research in this area keeps expanding. Thus, the goal of this review was to summarize recent research on the impact of medicinal plants on (1) enhancing reproductive performance as well as acting as an abortifacient; (2) preventing common parasitic infections in livestock, including insect pests in agriculture; (3) the antioxidant-defence potential of phytochemicals; and (4) some notable applications of ethnomedical plants (phytotherapy).

2. Effect of medicinal plants on reproductive parameters

Due to decreased milk supply, fewer calves born, and an increased culling rate, infertility in dairy cows results in significant financial losses for producers (Perumal *et al*. 2013) [129]. Herbs are considered alternative medications, and are very useful for managing diverse disorders in reproductive performances (Adeniran *et al*. 2020) [5]. The effectiveness of many medicinal herbs on reproductive performance in test animals has been supported by several studies (Shai *et al*. 2022) [144]. These studies have proven that medicinal plants provide potent alternative treatment for animal infertility (Biressaw 2017) [24]. Chandra & Purohit (2020) [27] listed a variety of medicinal plants; *Myrtus communis*, *Viola species*, *Nigella sativa*, *Pedalium murex*, *Entada pursaetha*, *Pandanus odoratissimus*, *Viburnum foetidum*, and *Plantago species* that are used to treat reproductive disorders, such as prolapse of the uterus, puerperal and uterine diseases. The chemical composition, antioxidant and antibacterial properties of *Alchornea cordifolia* help to treat infertility brought on by reduced spermatogenesis (Ebenyi *et al*. 2016) [40]. In Southeastern Nigeria, *Diospyros canaliculata* and *Diospyros mespiliformis* roots, stems, bark, and leaves are used for the treatment of infertility (Monier, 2016) [105]. According to Ogbuew *et al*. (2015) [116], *Ficus sycomorus*, *Monodora myristica*, *Uvaria chamae*, *Newbouldia laevis*, and *Xylopia aethiopica* are used for boosting animal conception rates. A decoction of deer horn glue (*Morinda officinalis*, Angelica liquorice), given to cows twice daily for three days, exhibited an efficacy of 88.9% against infertility (Liu *et al*. 2014) [87]. According to Cong *et al*. (2015) [29], common Cnidium fruit, yellow sophora root, Chinese goldthread rhizome, and licorice produced 100% recovery and fertility in the test animals. Safflower, cowherb seed, Epimedium, Actinolite, *Morinda officinalis*, *Fructus psoraleae*, *Astragalus membranaceus*, *Ligusticum wallichii*, *Semen cuscutae*, and Kudzu vine root demonstrated extremely high efficacy in increasing conception rates (He *et al*. 2012; Liu *et al*. 2013) [63, 86]. Saponins and alkaloids, the active components of fenugreek seeds (*Trigonella foenum-graecum*), improves animal performance (Ahmed, 2009) [9]. According to Hassan (2012) [61], fenugreek oil enhances ovarian activity. Rajkumar *et al*. (2008) [132] investigated the effects of *Trigonella foenum-graecum* seeds and *Saraca asoca* stem bark on reproductive function, serum progesterone levels, and micromineral profiles in anestrus cows and found that both the percentage of animals prompted to oestrus and overall pregnancy rate were high. According to a study by Kumar *et al*. (2015) [80], *Asparagus racemosus* is a scientifically proven tonic for the reproductive system, immunomodulator, antioxidant, and anti-stress agent. To boost the rate of conception, the whole *Hydrilla verticillata* plant, *Lens culinaris subsp. culinaris* seed, *Myristica fragrans*, *Ricinus communis*, *Triticum aestivum*, and *Pandanus tectorius* flower are given to both female and male (Kumar and Kumar, 2013) [81]. Repeat breeder cows have been treated successfully using medicinal plants including *Lawsonia inermis* (leaves), *Musa paradisiaca* (leaf extract), *Cordial sp.* (leaves), *Convolvulus microphyllus* (roots), *Cicer arietinum* (Germinated Bengal gramme), and *Pedalium murex* (fruits) (Das *et al*., 2002) [32]. *Radix bupleuri*, *Semen litchi*, Fennel, Frankincense, Notopterygium root, Peach kernel, Motherwort, *Radix codonopsis*, Safflower, Licorice, and others have been used to treat retained placenta with success (Lv *et al*. 2014; Chen et. 2015; Li *et al*. 2015) [90, 28, 85]. According to Dharani *et al*. (2015) [35], a variety of extracts made from the leaves of *Acalypha fruticosa*, *Aloe secundiflora*, the bark of *Acacia oerfota*, *Acacia drepanolobium*, and *Azadirachta indica* seeds are useful in treating venereal diseases. *Epimedium sagittatum*, also known as horny goat weed, is a popular aphrodisiac and boosts sperm cell production (Perumal *et al*. 2013) [129]. Studies on *Murraya koenigii* and *Aegle marmelos* separately and together have shown their potency in establishing estrus, ovulation, and pregnancy in anestrus goats, cows, and buffaloes. Additionally, *A. marmelos* and *M. koenigii* increased endogenous antioxidants while decreasing the bacterial load and inflammation in endometritic dairy cows (Ravi *et al*., 2018; Rautela *et al*., 2018) [136, 135]. Animals are given various mixtures of extracts made from the leaves of *Acalypha fruticosa*, *Tinospora cordifolia*, *Cassia fistula* bark, and *Artocarpus heterophyllus* L. to treat anestrous (Talukdar *et al*., 2015) [153].

Male factor infertility frequently occurs from testicular conditions that produce insufficient sperm, both in terms of number and quality. Studies utilizing various herbal products revealed both beneficial and harmful effects of several botanical products on the testes and spermatogenesis (Shepherd *et al*. 2022) [146]. Herbs and plants aid in sperm production, ejaculation strength, sperm volume, sperm counts, and overall sexual wellness (Kuralkar & Kuralkar, 2021) [84]. *Tribulus terrestris*, *Tinospora cordifolia*, *Eurycoma longifolia*, and *Leuzea carthamoides* feeding promotes daily sperm production, sperm survival, improved sperm survival time, increased semen volume, sperm motility, percentage of viable spermatozoa, sperm concentration, morphologically normal spermatozoa, and sex libido (Jayaganthan *et al*. 2013; Frydrychova *et al*. 2011) [70, 44]. Sexual activity and performance are enhanced by the ethanolic extract of *Cleome arabica* (Boublata *et al*. 2021; Habbachi *et al*. 2020) [25, 58]. Testicular oxidative damage, affecting the inflammatory response and apoptotic-related pathways, was lessened by green coffee administration. According to Wafa *et al*. (2020) [160], green coffee has an effect through boosting of antioxidant activity, reducing inflammatory response, and blocking the apoptotic pathway in the testes. Although it did not affect testosterone levels, *Ceratonia siliqua* L. syrup was said to be more effective than vitamin E at enhancing semen quality (Aghajani *et al*. 2021) [7]. It is important to note here that the testis is vulnerable to herbal medications on both ends. For instance, *Tripterygium wilfordii* and cotton seed-derived gossypol harm the testes and male fertility, whereas *Withania somnifera* and the Qilin Pill increase testosterone levels and spermatogenesis (Shepherd *et al*. 2022; Mukherjee *et al*. 2021; Durg *et al*. 2018; Lopez *et al*. 2005) [146, 108, 38, 89].

3. Abortifacient activity of medicinal plants

Many herbs used traditionally as contraceptives are spermicidal (Abu *et al*. 2012) [4], abortifacient (James *et al*. 2011) [67], decreasing implantation sites, and affecting oestrous cycle (Koneri *et al*. 2007; Oluyemi *et al*. 2007) [78, 120]. Due to its affordability, accessibility, and perceived lack of adverse effects, herbal contraceptives are in high demand (Abu *et al*. 2012) [4]. The aqueous leaf extract of *Annona senegalensis* has abortifacient properties since it decreases progesterone levels, decreases implantation sites, and causes foetus resorption and implantation losses (Mbaya *et al*. 2019) [101]. According to Asefa *et al*. (2021) [16], Ethiopian women use leaves of *Azadirachta indica* to induce abortion. The dietary spice *Curcuma longa* (turmeric), which is high in phytoestrogen, is also reported to have contraceptive properties (Ramadan *et al*. 2011; Habash *et al*. 2000) [133, 57].

Abortion is performed using a decoction made from the roots and leaves of *Combretum racemosum* P. Beauv. (Omotayo and Borokini, 2012; Ibe and Nwufo, 2005) [121, 64]. In some regions of Nigeria, *Lawsonia inermis* has been used to induce abortions (Uleh *et al*. 2017) [156]. The abortifacient activity of *Alstonia boonei*, *Rauvolfia vomitoria*, *Piper guineense*, *Zingiber officinale*, and *Spondias mombin* has been reported in Southeast Nigeria as well (Ogbuew *et al*. 2015) [116]. Gossypol, an extract from cotton seeds, was found to be an effective contraceptive and equally poisonous to testicles according to clinical investigations (Lopez *et al*. 2005) [89]. *Azadirachta indica* methanolic seed extract inhibited reproduction in female albino rats. Its mechanism of action may be hormonal, specifically through the suppression of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) (Njoga *et al*. 2022) [113].

4. Effects of medicinal plants on parasites

The utilization of indigenous beliefs, knowledge, skills, techniques, and practices relating to animal health care referred to as ethno-veterinary medicine (EVM) is an option for treating both internal and external parasites in cattle production systems (Mathius-Mundy & McCorkle, 2004) [100]. In the future, medicinal plants may be crucial in the control of helminth infections in tropical and subtropical countries because they are somewhat less hazardous and have fewer adverse effects (Balagizi *et al*. 2021) [18]. Treatment for parasitic infections may be improved with the use of herbal medications. Herbal therapy can treat and manage several parasitic infections (Jamil *et al*. 2022) [68]. The livestock business faces a significant global threat from intestinal helminth infections (Mechineni *et al*. 2014) [102]. Newbold *et al*. (2017) [110], also opined that helminthiasis is a persistent issue in the chicken business and causes significant financial losses. Local livestock breeders have used a variety of plants and plant-based products to manage parasites and increase livestock output (Abdu *et al*. 2000) [2]. According to Afolayan and Sowemimo (2022) [6] and Ouachinou *et al*. (2017) [117], *Vernonia amygdalina*, *Carica papaya*, and *Azadirachta indica* are used to treat intestinal worms. *Detarium microcarpum* has shown effective deworming activity and is also used to treat several ailments, including dysentery, diarrhoea, and genital disorders, in many parts of Africa (Akah *et al*. 2012) [11].

In several parts of China, traditional healers and farmers have employed plant ingredients extracted from leaves, roots, seeds, flowers, and bark as anthelmintic agents (Lv *et al*. 2014) [90]. In many regions of the world, medicinal herbs have been utilized for centuries to fight parasitism and are still used for this purpose today (Bauri *et al*. 2015) [19]. Essential oil from *Zanthoxylum simulans* demonstrated promising anthelmintic properties against *Haemonchus contortus* eggs and larvae. By the anthelmintic properties of its essential oil against nematodes, the traditional use of Z. *simulans* against intestinal parasites has been scientifically demonstrated (Qi *et al*., 2015) [131]. *Zanthoxylum armatum* leaf infusion and bark pastes are used to manage endoparasites. The same with *Schima wallichii* and *Aloe barbadensis* (Bhat *et al*. 2023) [22]. According to Bhat *et al*. (2023) [22], *Zanthoxylum armatum* leaves and bark extracts exhibit strong toxicity against endoparasites due to the presence of limonene, linalool, and cinnamic acid. *Leishmania* species (*L. major*, *L. braziliensis*, and *L. chagasi*) have been proven to be extremely susceptible to limonene. The larvae and adult stages of *H. contortus* exhibited less hatching and motility in response to crude extracts of *Artemisia herba-alba* and *Punica granatum*. As a result, they may be able to manage ruminant gastrointestinal parasites (Ahmed *et al*. 2020) [10]. *Punica granatum* significantly affects both protozoan infections (Dell'Agli *et al*. 2009) [34] and cestodes and nematodes (Abdel-Ghaffar *et al*. 2011) [1]. According to William *et al*. (2016) [163], the bark of the *Khaya senegalensis* tree is effective in the treatment of liver fluke. The effectiveness of plant-based alkaloids as an anthelmintic was validated by Wang *et al*. (2010) [161]. By inhibiting egg embryonation, lowering the number of faecal eggs, and decreasing the number of the parasite. *Vernonia amygdalina* extract and fractions showed antihelmintic efficacy against *Ascaridia galli* (Gasaliyu *et al*. 2022; Saftri *et al*. 2019) [50, 139]. *Heligmosomoides bakeri* mortality and *Ascaris suum* motility inhibition were both increased *in vitro* by the use of aqueous and ethanol leaf extracts from *V. amygdalina*, respectively (Nweze *et al*. 2013) [114]. *Connarus africanus* seed, root, and bark are anthelmintic. Helminth, filariasis, and malaria illnesses are treated with the leaves and roots of *Amaranthus viridis*. *Anogeissus leiocarpus* is said to be a taenicide and skin conditions are also treated with its bark, leaves, and seeds. *Cucurbita maxim* seeds and fruits are purportedly used to treat tapeworms. *Harungana madagascariensis*, *Embelia guineensis*, *Delonix regia*, *Antidesma venosum*, *Croton lobatus*, *Jussiaea linifolia*, *Ludwigia suffruticosa*, *Opilia celtidifolia*, *Areca catechu*, *Blighia sapida*, *Cola millenii*, *Clerodendrum capitatum*, *Afrormosia granum-paradisi*, *Boscia senegalensis*, and *Balanites aegyptiaca* have been utilized for the treatment of various parasites (Monier, 2016) [105]. *Khaya senegalensis* is used to treat guinea worms in some parts of Nigeria, while *Mangifera indica* and *Musa sapientum* are used to treat malaria parasites (Uleh *et al*. 2017) [156]. The methanolic and ethyl acetate extracts of *Psidium guajava* had potent anti-inflammatory and anticoccidial properties (Yamssi *et al*. 2018) [166].

Ecto-parasites, notably ticks and pathogens carried by ticks, are one of the main health issues affecting livestock (Schroeder & Reilly, 2013) [170]. Ticks have significant negative influence on the livestock business and cause significant financial losses (Patoliya *et al*. 2022) [126]. After 5 hours of treatment, extracts made from *Azadirachta indica* leaf, seed, and bark demonstrated a very high level of efficacy (80%) against ticks (Ghosh *et al*. 2015) [55]. In addition to having antifeedant actions against insects, *Azadirachta indica* also exhibits growth-regulating, ovipositor repellent, fecundity suppression, and sterilization activities that are utilized to control ectoparasites (Ponnusamy *et al*. 2016) [130]. Tick control in numerous animals was demonstrated by a herbal formulation containing *Tinospora cordifolia*, *Cucumis sativus*, *Azadirachta indica*, *Vitex negundo*, and *Acorus calamus* (Nimbalkar *et al*. 2020) [112]. By burning the leaves of *Vitex negundo*, the smoke produced is useful in controlling ticks and other ectoparasites (Kekuda and Mahalakshmi, 2020) [74]. In some South African villages, *Aloe ferox* is used as tick repellent (Moyo & Masika, 2009) [106]. In Zimbabwe, ectoparasites are managed with *Cissus quadrangularis*, *Lippia javanica*, *Psydrax livida*, and *Aloe species* (Nyahangare *et al*. 2015) [115]. For the treatment of wounds, dyspepsia, and ectoparasite control, *Acorus calamus* leaves are made into a decoction and placed on the affected skin part (. The leaves of *Coriandrum sativum*, *Chlorophytum arundinaceum*, *Albizia lebbeck*, and *Ocimum gratissimum* are utilized for the control of ectoparasites, as well (Bhat *et al*. 2023) [22].

5. Insecticidal effect of botanicals

Due to environmental contamination, insect resistance development, residual effects, and lack of activity specificity, the use of chemical insecticides to address insect problems has deteriorated into a serious global issue. Green pharmaceutics has come about as a result of the growing environmental pollution worries linked to various synthetic (insecticide) chemical wastes. Farmers use the burning of the leaves of specific plants to ward off insects (Hammad *et al*. 2011) [60]. A key ingredient that gives plants their insecticidal effect has been discovered as roemerine, an aporphine alkaloid (Magadula *et al*. 2009) [93]. Significant insecticidal efficacy against sheep and goat mange mites was found in *Eucalyptus globulus* essential oil in a dose-dependent manner. To guard against mosquitoes and other dangerous arthropods, Eucalyptus oil has shown great effectiveness as a natural insect repellent (Gemechu *et al*. 2019) [51]. Some plants have shown acaricidal action in different parts of the world, such as *Tephrosia vogelii* Hook. (Gadzirayi *et al*. 2009) [45] and *Azadirachta indica* A. Juss. (Benavides *et al*. 2001; Webb & David, 2002) [20, 162]. *Stylosanthes scabra*, & *Solanum dasyphyllum* (Van Puyvelde *et al*. 1985) [159], *Cleome gynandra* L. (Malonza *et al*. 1992) [97], and *Melinis minutiflora* P. Beauv. (de Barros & Evans 1989) [33] are a few examples of plants with similar characteristics. Using data from previous assessment of ethnobotanical knowledge (Stevenson *et al*. 2010) [151], Madzimure *et al*. (2011, 2013) [91-92] validated the acaricidal effects of *Lippia javanica* leaves (Burm. f.), *Solanum incanum* L. fruits, and *Strychnos spinosa* Lam. fruits in Zimbabwe. Tick populations on cattle were decreased by the plants' unprocessed water extracts (Nyahangare *et al*. 2015) [115].

Insecticidal action has been demonstrated in the roots of *Cucumis dipsaceus* and the leaves of *Acokanthera schimperi* (Damtew *et al*. 2012) [30]. In comparison to the favourable reference medications (Diazinon), Negessa *et al*. (2011) [109] found that *Cymbopogon citrus* oil had good activity against *Sarcoptes scabiei var. caprea* mange mites on naturally affected goats. Additionally, *Cymbopogon citratus* essential oil exhibits stronger insecticidal action against sheep ked than the positive control (Diazinon), according to Gemeda *et al*. (2014) [52]. On rabbits and goats, other plant substances, such as linalool, also demonstrated acaricidal efficacy against the psoroptes mite. Additionally, *Pediculus humanus capitis* was resistant to the insecticidal effects of linalool and cinnamyl acetate (Yang *et al*. 2004) [67]. According to Zeneida *et al*. (2015) [168], medicinal plants with acaricidal qualities also have the advantages of being relatively non-toxic to mammals and low environmental toxicity. These findings support the idea that using herbal acaricides can be a more effective and safer alternative to conventional mange treatments in domestic animals (Gemechu *et al*. 2019) [51].

6. Ethnobotanicals in insect pest control

Agricultural crops are frequently exposed and put at risk by insect pests, which affects their growth and quality over time (Archana, 2014; Donatelli *et al*. 2017) [13, 36]. According to Sindhu *et al*. (2010) [147], plants constitute an essential part of both traditional remedies and insecticides. Plant-based therapies were widely used for pest management prior to the development of synthetic pesticides (Mahmood *et al*. 2016) [96]. Numerous crop pests have been managed using plants that contain bioactive compounds (Thiruppathi *et al*. 2010) [154]. Numerous studies using known and untapped plant species with pesticidal properties have been carried out (Erenso and Berhe, 2016) [46]. Pyrethrum (*Tanacetum cinerariifolium*) flowers have been successfully employed as sources of safe pesticides for the management of insect pests (Sarwar, 2015) [141]. Examples of plants that are sources of commercially available botanical pesticides include pyrethrum (*Tanacetum cinerariifolium*), neem (*Azadirachta indica*), sabadilla (*Schoenocaulon officinale*), tobacco (*Nicotiana tabacum*), and ryania (*Ryania speciosa*) (Arnason *et al*. 2012) [14]. Due to their various methods of action, botanical pesticides have been demonstrated to effectively manage a variety of agricultural pest species, frequently outperforming synthetic chemicals (Sola *et al*. 2014; Benelli *et al*. 2019; Stefanidesova *et al*. 2017) [149, 21, 150]. A botanical pesticide can repel insects, keeping them away from treated materials by stimulating their olfactory receptors (Isman, 2006) [66]. This protects crops while having a low influence on the ecology. The essential oils of *Ziziphora tenuior*, *Myrtus communis*, *Achillea wilhelmsii*, and *M. piperita* have been found by Ghavami *et al*. (2017) [54] to exhibit repelling properties against insect pests and even human fleas. Due to the essential oils' repellant action on *Tribolium confusum*, showed the effectiveness of *M. piperita*, *R. officinalis*, and *Coriandrum sativum* oils for application in organic food protection from insect pests. According to Zhang *et al*. (2017) [169], T. *castaneum* and *L. serricorne* adults are two storage pests that these six Zanthoxylum species' essential oils have been shown to repel. These essential oils come from *Z. armatum*, Z. *dimorphophyllum*, *Z. dimorphophyllum* var. s*pinifolium*, *Z. piasezkii*, *Z. stenophyllum*, and *Z. dissitum*. The effects of *Cymbopogon citratus* and *Thymus minuta* essential oils on the sandfly *Phlebotomus duboscqi* were demonstrated by Kimutai *et al*. (2017) [76]. Tannins, saponins, flavonoids, steroids, and alkaloids-all phytoconstituents-found in the leaf extract of *Khaya senegalensis* caused *Dinoderus porcellus* mortality (Loko *et al*. 2017) [88]. Granary weevil adults were successfully fumigated and killed by *Lavandula angustifolia* essential oil. Additionally, granary weevil orientation to a desirable host substrate can be disrupted by its strong repellent function (Germinara *et al*. 2017) [53].

7. Medicinal plants and antioxidant defense systems

There is a huge diversity of minerals and phytochemicals found in medicinal plants. In addition to their mineral components, these plants' actions are principally centred on reducing oxidative stress (Shakoor *et al*. 2021) [18]. Food antioxidants are notably important for maintaining health and vigour (Manivannan *et al*. 2016) [98]. To support claims made in folklore, Pawa *et al*. (2011) [128] conducted pharmacological investigations on *Sida cordifolia* for anthelmintic and antioxidant activity. The plant's aqueous and ethanolic extracts demonstrated anthelmintic and antioxidant properties. Due to the presence of phytoconstituents like flavonoids (5,7-dihydroxy-3-isoprenyl flavone and 5-hydroxy-3-isoprenyl flavone), phenolic compounds, and alkaloids (Asparagin, ephedrine, vascicinone, vascinol, and pseudoephedrine), the ethanolic extract produced more significant results. *Detarium microcarpum* has a wealth of antioxidant characteristics, according to various studies (Hassanin *et al*. 2018; Meda *et al*. 2017) [62, 103], and it is effective in treating several disease conditions, including diabetes, cancer (Ngulde *et al*. 2015) [111], helminthiasis (Haladu *et al*. 2020) [59], and others. At 10 mg/ml, *D. microcarpum* demonstrated strong antibacterial activity against *Salmonella paratyphi*, *Bacillus subtilis*, *Staphylococcus aureus*, *Candida albicans*, *Pseudomonas aeruginosa*, and *Escherichia coli* (Semde *et al*. 2018; Ebi &

Afieroho, 2011) [143, 41]. Seeds of *Abrus precatorius* decrease ROS formation in hepatocarcinogenesis and increase the antioxidant defence system; protecting the kidney from alcohol-induced parenchymal injury (Pal *et al*. 2009; Kartik *et al*. 2010) [124, 73]. *Alpinia galanga* rhizomes are used to treat indigestion, bronchial catarrh, rheumatism, ulceration, helminth infection, dementia, and fever due to their rich radical scavenging activity, reducing properties, metal ion chelating, and beta carotene bleaching properties (Mahae and Chaiseri 2009; Wong *et al*. 2009) [94, 164]. Roots, bark, and fruit of *Berberis aristata* have been used successfully to treat skin conditions, jaundice, and eye infections attributable to their radical scavenging characteristics (Singh and Kakkar 2009; Andola *et al*. 2011) [148, 12]. According to Kucukboyaci *et al*. (2010) [79], lignan derivative chemicals in *Taxus baccata* (Leaves, Bark) demonstrated antioxidant, anti-inflammatory, antinociceptive, anti-ulcerogenic, and cytotoxic effects. Due to its potent antioxidant and free radical scavenging qualities, the roots of *Valeriana jatamansi* have been used to treat ulcers, wounds, epilepsy, dyspepsia, flatulence, colic, constipation, jaundice, dry cough, asthma, seminal weakness, and neurological problems (Kalim *et al*. 2010; Bhatt *et al*. 2012) [71, 23]. According to studies conducted by Ganie *et al*. (2011) [49], a *Podophyllum hexandrum* aqueous extract can shield kidney and lung tissue from CCl4-induced oxidative stress. According to studies (Mubashir *et al*. 2020; Shekarchi *et al*. 2012) [107, 145], rosmarinic acid isolated from *Ocimum basilicum* exhibits antioxidant, anti-inflammatory, and neuroprotective properties.

8. A few notable applications of phytotherapy

A conventional strategy used to address women's health issues is called ethnogynecology (Aziz *et al*. 2018) [17]. Women continue to favour traditional remedies for a variety of reasons in different parts of the world, including Latin America, Africa, and Asia (van Andel *et al*., 2014) [158]. *Withania somnifera* is used as a uterine tonic and has been demonstrated in studies to increase semen output as well (Aziz *et al*. 2018) [17]. The pharmacological effects of *W. somnifera* are thought to be mediated by steroidal lactones and the basic withanolides, withaferin A and D (Umadevi *et al*. 2012) [157]. Since ancient times, *Nigella sativa* seed has mostly been used as an abortifacient to treat sexual abnormalities (Iqbal *et al*. 2010) [65]. Clotrimazole vaginal cream combined with *N. sativa* capsules was discovered to be more effective than clotrimazole vaginal cream alone. In order to cure *Candida albicans* vaginitis, *N. sativa* pills are advised (Fard *et al*. 2015) [42]. A widely used traditional medicine in humans is *Asparagus racemosus* root, which is supplemented from the last trimester of pregnancy to the first few weeks after birth to improve milk quality, boost foetal and maternal immunity, and tone the reproductive system and promote reproductive health (Kumar *et al*. 2010) [82].

Cirrhosis is one disease that the hepatitis C virus (HCV) can lead to (Karoney & Siika, 2013) [72]. Several African medicinal plants, have been used to cure liver conditions (Galani *et al*. 2015) [48]. There have been reports of antiviral activity in the *Detarium microcarpum* fractions, for instance; the Hepatitis C virus (HCV) was specifically suppressed by the active component of MTH-1700 (Olugbuyiro *et al*. 2009) [119]. The use of plants in conventional cancer treatments, such as *Securidaca longipedunculata*, and *Andira inermis subsp. rooseveltii*, *Pterocarpus erinaceus*, *Carissa edulis spp.*, *Detarium microcarpum*, *Cassia sieberiana*, etc., has been supported by several scientific studies (Ngulde *et al*. 2015) [111]. According to Mahmood *et al*. (1993) [95], flavones in the methanol extract of *D. microcarpum* can significantly suppress HIV-1 and HIV-2 Acetylcholinesterase (AChE) was demonstrated to be inhibited by clerodane-type diterpenes that were extracted from *D. microcarpum* fruits by Cavin (2007) [26]. The best method for treating Alzheimer's disease symptoms at the moment is AChE inhibition. One of the substances, 2- oxokolavenic acid, was ten times more potent than galanthamine, a treatment for Alzheimer's disease that has been therapeutically successful. *Annona senegalensis* has been reported to be effective in treating epilepsy, and several researches has supported its anticonvulsant claims (Konate *et al*. 2012; Dongmo *et al*. 2014; Okoye *et al*. 2013) [77, 37, 118]. *Annona senegalensis* has been used to also treat malaria in Guinea. As evidenced by the increased RBC, Hb, and PCV levels, jackfruit (*Artocarpus heterophyllus*) diets have some anti-anemic characteristics (Agiang *et al*. 2017) [8]. According to Yakubu *et al*. (2017) [165], the ethanolic extract of *Hymenocardia acida* leaves has a modestly ameliorative impact on the toxicity caused by aluminium chloride.

9. Conclusion

This review is an update of previously published scientific data that supports folkloric uses of plant extracts and traditional knowledge in production, management of reproductive problems and diseases, control of parasites, insects and insect pests in agriculture. These days, herbs are making a comeback. This is mostly caused by increasing microbial resistance, cost, environmental degradation, and worries about the safety of synthetic chemicals and pharmaceuticals. An effective option for future remediation is ethnobotanical plants. Hence consistent research and update of findings in ethnomedicinal plant studies remain key to developing standard guideline for their application while providing reference for further studies on the subject.

Authors contribution

MYP conceived the study, reviewed and edited the manuscript. OM, AFO & OIM wrote various aspects of the manuscript. All authors read and approved the final manuscript for publication.

Informed Consent Statement

Not applicable

Conflicts of Interest

The authors declare no conflict of interest

10. References

1. Abdel-Ghaffar F, SemmLer M, Al-Rasheid KA. The effects of different plant extracts on intestinal cestodes and on trematodes. Parasitology Research. 2011;108(4):979-984.
2. Abdu PA, Jagun AG, Gefu JO, Mohammed AK, Alawa CBI, Omokanye AT. A survey of ethnoveterinary practices of agropastoralists in Nigeria. In: Gefu, J.O., Abdu, P.A., Alawa, C.B.I. (Eds.), Ethnoveterinary practices, research and development, Proceedings of the International Workshop on Ethnoveterinary Practices, Kaduna, Nigeria, 14–18 August NAPRI/ABU, Zaria; c2000.
3. Abera Y, Mulate B. Ethno-veterinary medicine: A potential alternative to animal health delivery in Wolmera district, Oromia Region, Ethiopia. Ethiop. Vet. J. 2019;23(1):111-130.

4. Abu AH, Ahemen T, Ochalefu DO, Akogwu AM. Evaluation of spermicidal property of aqueous ethanolic extract of Lawsonia inermis Lnn. leaves. Scholars Research Library. Annals of Biol Res. 2012;3(8):3846-3848.
5. Adeniran AL, Okpi S, Anjorin TS, Ajagbonna OP. Medicinal plants used in ethnoveterinary practices in the Federal Capital Territory, North-Central Nigeria. Journal of Medicinal Plants Research. 2020;14(8):377-388, August, 2020 DOI: 10.5897/JMPR2020.6975
6. Afolayan FID, Sowemimo R. Ethnobotanical study of plants used for treating intestinal worms in Ibadan, Nigeria. The Zoologist. 2022;21:32-40. http://dx.doi.org/10.4314/tzool.v21i1.6
7. Aghajani MMR, Mahjoub S, Mojab Namdari M, Gorji NM, Dashtaki A, Mirabi P. Comparison of the effect of *Ceratonia siliqua* L. (Carob) syrup and vitamin E on sperm parameters, oxidative stress index, and sex hormones in infertile men: a randomized controlled trial. Reprod. Sci. 2021;28:766-774.
8. Agiang MA, Dongo BS, Okon IW, Ashang BU. Assessment of the haematological indices of albino rats fed diets supplemented with jackfruit bulb, seed or a blend of bulb and seed. 2017;11:1 DOI: 10.4314/ijbcs.v11i1.31
9. Ahmed BM. Effect of fenugreek (*Trigonella foenum-graecum*) seeds as feed additive on production performance of dairy goats, Ph.D. thesis work, NDRI, Karnal; c2009.
10. Ahmed HA, Ejo M, Feyera T, Regassa D, Mummed B, Huluka AS. *In vitro* Anthelmintic Activity of Crude Extracts of Artemisia herba-alba and *Punica granatum* against Haemonchus contortus. Journal of Parasitology Research. Article ID 4950196; c2020. p. 7 https://doi.org/10.1155/2020/4950196
11. Akah P, Nworu C, Mbaoji F, Nwabunike I, Onyeto C. Genus Detarium: Ethnomedicinal, phytochemical and pharmacological profile. Phytopharmacology. 2012;3:367-3753.
12. Andola HC, Rawal RS, Bhatt ID. Comparative studies on the nutritive and anti-nutritive properties of fruits in selected Berberis species of West Himalaya, India. Food Res Int. 2011;44:2352-2356.
13. Archana SK. Biopesticides for integrated crop management: environmental and regulatory aspects. J. Biofertil. Biopestic. 2014, 05. http://dx.doi.org/10.4172/2155- 6202.1000e121
14. Arnason JT, Sims SR, Scott IM. Natural products from plants as insecticides, phytochemistry and pharmacognosy; c2012 www.eolss.net/Sample-AllChapter.aspx/C06/E6-151.
15. Arruda DC, Miguel DC, Yokoyama-Yasunaka JKU, Katzin AM. Uliana SRB. Inhibitory activity of limonene against *Leishmania* parasites *in vitro* and *in vivo*, Biomed, Pharma 2009;63:643-649, https://doi.org/10.1016/j.biopha.2009.02.004.
16. Asefa I, Asmare A, Regassa F, Fekadu A, Tariq KA. Ethno-veterinary medicinal plants and modes of their traditional application to cure animal ailments in Adaa'Liben district, Ethiopia. East Afr. J. Biophys. Comput. Sci. 2021;2(1):48-63
17. Aziz MA, Khan HA, Ullah H, Adnan M, Hashem A, Abd-Allah EF. Traditional phytomedicines for gynecological problems used by tribal communities of Mohmand Agency near the Pak-Afghan border area. Revista Brasileira de Farmacognosia 2018;28:503-511.
18. Balagizi I, Hirt H, Lindsey K, Mbuta K, M'Pia B. Natural Medicine in the Tropics: Treatments. 2017 Shakoor H, Feehan J, AlDhaheri AS, Ali HI, Platat C, Is mail LC, Apostolopoulos V, Stojanovska L. Immune-boosting role of vitamins D, C, E, zinc, selenium and omega-3 fatty acids: could they help against COVID-19 Maturitas. 2021;143:1-9.
19. Bauri RK, Tigga MN, Kullu SS. A review on use of medicinal plants to control parasites. 2015;6:268-277.
20. Benavides E, Hernández G, Romero N, Castro A, Rodrígues B. Preliminary evaluation of Neem (*Azadirachta indica*) extracts as an alternative for cattle tick, *Boophilus microplus* control. Rev Colomb Entomol. 2001;27(1-2):1-8.
21. Benelli G, Pavela R, Maggi F, Nkuimi Wandjou JG, Yvette Fofie NGB, Koné-Bamba D, *et al*. Insecticidal activity of the essential oil and polar extracts from Ocimum gratissimum grown in Ivory Coast: Efficacy on insect pests and vectors and impact on non-target species. Industrial Crops and Products, 2019;132:377-385. doi: 10.1016/j.indcrop.2019.02.047
22. Bhat AN, Jeri L, Karmakar D, Mipun P, Bharali P, Sheikh N, *et al*. Ethnoveterinary practises of medicinal plants used for the treatment of different cattle diseases: A case study in East Khasi Hill district of Meghalaya, North East India. Heliyon. 2023;9:e18214 https://doi.org/10.1016/j.heliyon.2023.e18214
23. Bhatt ID, Dauthal P, Rawat S, Gaira KS, Jugran A, Rawal RS, *et al*. Characterization of essential oil composition, phenolic content, and antioxidant properties in wild and planted individuals of *Valeriana jatamansi* Jones. Sci Hort. 2012;136:61-68.
24. Biressaw S. Documentation of ethnoveterinary knowledge among the Somali pastoral community in eastern part of Ethiopia: with special emphasis on herbal medicine for livestock health. Adv Biol Res (Rennes). 2017;11(6):339-347.
25. Boublata NI, Habbachi S, Saadane FZ, Bouzar A, Habbachi W, Benhissen S. Effects of ethanolic extract of the *Cleome arabica* on sexual behavior in Wistar rats. J Anim Behav Biometeorol. 2021;9:2135.
26. Cavin A. Contribution to the taxonomic and chemical knowledge of African fruits of the genus Detarium (Fabaceae - Caesalpinioideae): D. microcarpum Guill. et Perr. and edible and toxic forms of D. senegalense J.F. Gmel. PhD thesis, University of Geneva, 2007, 278.
27. Chandra SS, Purohit GN. Use of ethno-veterinary medicine for therapy of reproductive disorders in cattle. Journal of Entomology and Zoology Studies. 2020;8(2):1006-1016.
28. Chen G, Lin C, Wu B. Traditional Chinese medicinal composition used for retaining bovine placenta after child birth, comprises Angelica, Talcum, Rehmannia root, Radix astragali, Tuckahoe, Peach kernel, Motherwort, Radix codonopsis, safflower and licorice. Patent No. CN104352628; c2015.
29. Cong R, Du J, Ge B, Ge D, Liu L. Chinese traditional medicinal perfusate useful for preventing and treating e.g. endometritis and infertility, comprises common cnidium fruit, light yellow sophora root, rhizome of Chinese goldthread and licorice. Patent No. CN101606992; c2015.
30. Damtew B, Zemede A, Beyene P, Habte T. Ethnobotanical study of plants used for protection against

insect bite and for the treatment of livestock health problems in rural areas of Akaki District, Eastern Shewa, Ethiopia. Topclass Journal of Herbal Medicine. 2012;1(2):12-24.
31. Das G, Kaufmann F, Abel H, Gauly M. Efect of extra dietary lysine in *Ascaridia galli*-infected grower layers. Vet Parasitol. 2010;170:238-243.
32. Das P, Das SK, Arya HPS, Subba Reddy G, Mishra A. Veterinary Science and Animal Husbandry. In: Inventory of indigenous technical knowledge in agriculture, Document 1 ICAR, New Delhi, 2002, 185-285.
33. De Barros ATM, Evans DE. Effects of some pasture grasses on infestive larvae of the cattle tick *Boophilus microplus*. Pesquisa Vet Brasil. 1989;9(1-2):17-21.
34. Dell'Agli M, Galli GV, Corbett Y. Antiplasmodial activity of *Punica granatum* L. fruit rind, Journal of Ethnopharmacology, 2009;125(2):279-285.
35. Dharani N, Yenesew A, Aynekulu E, Tuei B, Jamnadass R. Traditional ethnoveterinary medicine in East Africa: A manual on the use of medicinal plants. Dawson IK ed. The World Agroforestry Centre (ICRAF), Nairobi, Kenya; c2015.
36. Donatelli M, Magarey RD, Bregaglio S, Willocquet L, Whish JPM, Savary S. Modelling the impacts of pests and diseases on agricultural systems. Agric. Syst; c2017 http://dx.doi.org/10.1016/j.agsy.2017.01.019
37. Dongmo NM, Fokunang C, Fekam BF, Tazoacha A. Anticonvulsant activity of extracts from six Cameroonian plants traditionally used to treat epilepsy. Int. J Biol Chem Sci. 2014;8(6):2407-2415.
38. Durg S, Shivaram SB, Bavage S. *Withania somnifera* (Indian ginseng) in male infertility: An evidence-based systematic review and meta-analysis. Phytomedicine 2018;50:247-256.
39. Dzoyem JP, Tchuenteu RT, Mbarawa K, Keza A, Roland A, Njouendou AJ. Ethnoveterinary Medicine and Medicinal Plants Used in the Treatment of Livestock Diseases in Cameroon. In: McGaw LJ, Abdalla MA editors. Ethnoveterinary Medicine: Present and Future Concepts. Cham: Springer; c2020 doi: 10.1007/978-3-030-32270-0_9
40. Ebenyi LN, Ogbanshi ME, Akubugwo EI, Agbafor KN, Inya-Agha OR. Aphrodisiac Effect of Aqueous and Ethylacetate Leaf Extracts of *Alchornea cordifolia* on Male Spermatogenesis. World Applied Sciences Journal. 2016;34(3):318-322.
41. Ebi GC, Afieroho OE. Phytochemical and antimicrobial studies on *Detarium microcarpum* Guill and Sperr (Caesalpinioceae) seeds coat. African Journal of Biotechnology. 2011;10(3):457-462.
42. Erenso TF, Berhe DH. Effect of neem leaf and seed powders against adult maize weevil (*Sitophilus zeamais* Motschulsky) mortality. Agricultural Research. 2016;2:90-94.
43. Fard FA, Zahrani ST, Bagheban AA, Mojab F. Therapeutic effects of Nigella sativa Linn (black cumin) on Candida albicans vaginitis. Arch. Clin. Infect. Dis. 2015, 10. http://dx.doi.org/10.5812/archcid.22991
44. Frydrychova S, Opletal L, Macakov AK, Lustykova A, Rozkot M, Lipensky J. Effects of herbal preparation on libido and semen quality in boars. Reprod. Dom; c2011.
45. Gadzirayi CT, Mutandwa E, Mwale M, Chindundu T. Utilization of Tephrosia vogelii in controlling ticks in dairy cows by small-scale commercial farmers in Zimbabwe. Afr J Biotechnol. 2009;8:4134-6.
46. Gainza YA, Santos IB, Figueiredo A, Santos LAL, Esteves SN, Barioni-Junior W. Anthelmintic resistance of Haemonchus contortus from sheep flocks in Brazil: concordance of *in vivo* and *in vitro* (RESISTA-Test©) methods. Braz J Vet Parasitol 2021;30(2):e025120. https://doi.org/10.1590/S1984-296120201093
47. Gakuubi W. A survey of plants and plant products traditionally used in livestock health management in Buuri district, Mery Country, Kenya. J. Ethnobiol. Ethnomedic. 2012;8:39
48. Galani BRT, Sahuc ME, Njayou FN, Deloison G, Mkounga P, Feudjou Seron K. Plant extracts from Cameroonian medicinal plants strongly inhibit hepatitis C virus infection *in vitro*. Frontiers in Microbiology. 2015, 6.
49. Ganie SA, Haq E, Hamid A, Qurishi Y, Mahmood Z, Zargar BA, *et al*. Carbon tetrachloride induced kidney and lung tissue damages and antioxidant activities of the aqueous rhizome extract of *Podophyllum hexandrum*. BMC Complem Altern Med. 2011;28(11):17.
50. Gasaliyu AK, Ajanusi OS, Suleiman MM, Sani D, Kuburat HY, Kyari S, *et al*. Effect of *Vernonia amygdalina* methanol leaf extract and fractions on *Ascaridia galli* in Experimentally Infected Birds and Pathology in the Treated Birds. Bulletin of the National Research Centre 2022;46:131 https://doi.org/10.1186/s42269- 022-00819-8
51. Gemechu W, Meresa A, Teka F, Berhau T, Tadele A. An ethno botanical review on medicinal plants used for the management ectoparasitic skin diseases of ruminants. Journal of Medicinal Plants Studies. 2019;7(4):212-224.
52. Gemeda N, Mokonnen W, Lemma H, Tadele A, Urga K, Addis G. Insecticidal Activity of Some Traditionally Used Ethiopian Medicinal Plants against Sheep Ked Melophagus ovinus. Journal of Parasitology Research. 2014;1-8:39.
53. Germinara GS, Distefano MG, Acutis LD, Pati S, Delfne S, Cristofaro AD, *et al*. Bioactivities of Lavandula angustifolia essential oil against the stored grain pest Sitophilus granaries. Bulletin of Insectology. 2017;70(1):129-138.
54. Ghavami M, Poorrastgoo F, Taghiloo B, Mohammadi J. Repellency Effect of Essential Oils of some Native Plants and Synthetic Repellents against Human Flea, Pulex irritans (Siphonaptera: Pulicidae). Journal of Arthropod-Borne Diseases. 2017;11:105-115.
55. Ghosh S, Tiwari S, Kumar B, Srivastava S, Sharma AK, Kumar S, *et al*. Identification of potential plant extracts for anti-tick activity against acaricide resistant cattle ticks, Rhipicephalus (Boophilus) microplus (Acari: Ixodidae). Experimental & applied acarology. 2015, 66. 10.1007/s10493-015-9890-7.
56. Gude D. Indigenous medicines: A wake-up slap. Indian J Public Health. 2013;57(57):183-184.
57. Habash M, Amran M, Mackeen MM, Lajis NH, Kikuzaki H, Nakatani H, *et al*. Screening of zingiberaceae extract for antimicrobial and antioxidant activities. J Ethanopharmacol. 2000;92:403-410.
58. Habbachi S, Boublata NEI, Benhissen S, Habbachi W, Khellaf Rebbas R, Tahraoui A. Evaluation of *Cleome arabica* L. (Capparidaceae) toxicity: effects on mortality and sexual behaviour of Drosophila melanogaster (diptera: drosophilidae). Current Trends in Natural Sciences. 2020;9:210-217.
59. Haladu AG, Hamdan A, Nik-Ahmad IIN. The efficacy of

aqueous and methanol extracts of *Detarium microcarpum* against migration of *Ostertagia ostertagi* and *Trichostrongylus colubriformis*. Bima Journal of Science and Technology, 2020;3(2) 59 – 69
60. Hammad F, Koua M, Babiker HA, Halfawi A, Ibrahim RO. Phytochemical and biological study of Striga hermonthica (Del.) Benth callus and intact plant. Research in Pharmaceutical Biotechnology 2011;3(7):85-92.
61. Hassan BAR. Medicinal plants (importance and uses) Pharmaceutica Analytica Acta. 2012, 3(10) doi: 10.4172/2153-2435.1000e139. –
62. Hassanin HAM, Koko M, Abdalla M, Mu W, Jiang B. *Detarium microcarpum*: a novel source of nutrition and medicine: a review, Food Chemistry doi: 2018. https://doi.org/10.1016/j.foodchem.2018.09.070
63. He H, Hou L, Ji W, Zhao G, Zhao S. Traditional Chinese medicine composition used for treating infertility in cows, comprises extracts of Herba epimedii, Fructus psoraleae, Semen cuscutae, Morinda officinalis, safflower, kudzu vine root, and cowherb seed. Patent No. CN102512525; c2012.
64. Ibe AE, Nwufo MI. Identification, collection and domestication of medicinal plants in southern Nigeria. Afr. Dev. 2005;30(3):66-77.
65. Iqbal MS, Qureshi AS, Ghafoor A. Evaluation of Nigella sativa L. for genetic variation and ex-situ conservation. Pak. J. Bot. 2010;42:2489-2495.
66. Isman MB. Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. Annual Review of Entomology, 2006;51:45–66. https://doi.org/10.1146/annurev.ento.51.110104.151146
67. James AB, Saibu GM, Magbagbeola OA, Oloyo AK, Iwalokun BA. The possible biochemical mechanism of action of petroleum ether extract of Calotropis procera leaves (Asclepiadaceae) – A potent abortifacient in gravid Dawley rats. Asian J Med Sciences. 2011;3(2):61-66.
68. Jamil M, Aleem MT, Shaukat A, Khan A, Mohsin M, Rehman T, *et al*. Medicinal Plants as an Alternative to Control Poultry Parasitic Diseases. Life 2022;12:449. https://doi.org/ 10.3390/life12030449
69. Jamshidi-Kia F, Lorigooini Z, Amini-Khoei H. Medicinal plants: Past history and future perspective. Journal of Herb Med Pharmacology. 2018;7:1-7. 10.15171/jhp.2018.01.
70. Jayaganthan P, Perumal P, Balamurugan TC, Verma RP, Singh LP, Pattanaik AK, *et al*. Effects of Tinospora cordifolia supplementation on semen quality and hormonal profile in ram. Anim. Reprod. Sci. 2013;140(1):47-53. https://doi.org/10.1016/j.anireprosci.2013.05.003.
71. Kalim MD, Bhattacharyya D, Banerjee A, Chattopadhyay S. Oxidative DNA damage preventive activity and antioxidant potential of plants used in unani system of medicine. BMC Complem Altern Med. 2010;10:77.
72. Karoney MJ, Siika AM. Hepatitis C virus (HCV) infection in Africa: a review. Pan African Medical Journal. 2013, 14(1).
73. Kartik R, Rao CV, Pushpangadan P, Trivedi SP, Reddy GD. Exploring the protective effects of *Abrus precatorius* in Hep G2 and N-nitrosodiethylamine-induced hepatocellular carcinoma in swiss albino rats. Ir J Pharm Sci. 2010;6:99-114.
74. Kekuda PTR, Mahalakshmi SN, Ethnoveterinary potential of *Vitex negundo* L. (Lamiaceae) – A review. In: Kekuda PTR, Vinayaka KS, Raghavendra HL (Editors), Nature and Medicine: Traditional Uses, Chemistry and Bioprospecting of Natural Products. JPS Scientific Publications, Tamil Nadu, India, 2020, 89-101.
75. Kelly K. History of Medicine. New York Facts on File. 2009, 29-50.
76. Kimutai A, Ngeiywa M, Mulaa M. Repellent effects of the essential oils of Cymbopogon citratus and Tagetes minuta on the sandfly, *Phlebotomus duboscqi*. BMC Res Notes 2017;10:98. https://doi.org/10.1186/s13104-017-2396-0
77. Konate A, Sawadogo W, Dubruc F, Caillard O, Ouedraogo M, Guissou I. Phytochemical and Anticonvulsant Properties of Annona senegalensis Pers. (Annonaceae), Plant Used in Burkina Folk Medicine to Treat Epilepsy and Convulsions. Br. J Pharmacol Tox. 2012;3(5):245-250.
78. Koneri R, Saraswati CD, Balaraman R, Ajeesha EA. Antiimplantation activity of the ethanolic root extract of Mordica cymbalaria fenzl in rats. Indian J. Pharmacol. 2007;39:90-96.
79. Kucukboyaci N, Orhan I, Ener BS, Nawaz SA, Iqbal MC. Assessment of enzyme inhibitory and antioxidant activities of lignans from *Taxus baccata*. L Z Naturforsch 2010;65c:187–194
80. Kumar KV, Prasanna KS, Ashadevi JS. Asparagus racemosus extract increases the life span in Drosophila melanogaster. J App Biol Biotech. 2015;3(04):049-055.
81. Kumar R, Kumar AB. New claims in folk veterinary medicines from Uttar Pradesh, India. Journal of Ethnopharmacology; c2013. http://dx.doi.org/10.1016/j.jep.2013.01.030.
82. Kumar S, Mehla RK, Gupta AK, Meena RK. Influence of Asparagus racemosus (Shatavari) supplementation during different stage of lactation on estrus behavior and reproductive performance in Karan Fries crossbred cows. Livestock Research for Rural Development. 2010, 22(5).
83. Kumar A, Kumar D, Shukla P, Kumar A. Botanicals: Towards the Eco-Friendly Approach for Pest Management. 2022;4:837-839.
84. Kuralkar P, Kuralkar SV. Role of herbal products in animal production – An updated review. Journal of Ethnopharmacology 278 2021;(11):4246, 1-11 https://doi.org/10.1016/j.jep.2021.114246
85. Li H, Wang X, Tian W, Cao R, Cong X. Traditional Chinese medicinal composition useful for e.g. treating retained placenta and strengthening uterine contractions in cattle, contains Angelica, garden balsam, Rhizoma ligustici wallichii, Radix codonopsis and motherwort Patent No. CN104173660; c2015.
86. Liu A, Xia X, Ma L, Cheng Z. Traditional Chinese medicine composition, e.g., for treating dairy cow endometritis and endometrium infertility, comprises Epimedium, actinolite, *Astragalus membranaceus*, *Ligusticum wallichii*, and Semen allii tuberosi. 2013. Patent No. CN102114171
87. Liu Z, Pei Y, Su Y, Wang H. Traditional Chinese medicinal composition useful e.g., for treating repetitive mating sterility of cows, nourishing yin, regulating blood and warming uterus, comprises e.g. deer horn glue, Morinda officinalis, angelica and liquorice. Patent No. CN102247505; c2014.
88. Loko LY, Alagbe O, Dannon EA, Datinon B, Orobiyi A,

Thomas-Odjo A, *et al*. Repellent effect and insecticidal activities of Bridelia ferruginea, *Blighia sapida*, and Khaya senegalensis leaves powders and extracts against Dinoderus porcellus in infested dried yam chips. Psyche, Article ID 5468202; c2017. p. 18.
89. Lopez LM, Grimes DA, Schulz KF. Nonhormonal drugs for contraception in men: a systematic review. Obst. Gynecol. Surv. 2005;60:746-752.
90. Lv W, Sun T, Zou J. Traditional Chinese medicinal composition useful for e.g., treating retention of placenta afterbirth in horse contains fructus Meliae toosendan, Radix bupleuri, Semen litchi, fennel, frankincense and Notopterygium root. Patent No. CN103751371; c2014.
91. Madzimure J, Nyahangare ET, Hamudikuwanda H, Hove T, Stevenson PC, Belmain SR. Acaricidal efficacy against cattle ticks and acute oral toxicity of *Lippia javanica* (Burm. F) Spreng. Trop Anim Health Pro. 2011; 43:481–9
92. Madzimure J, Nyahangare ET, Hamudikuwanda H, Hove T, Stevenson PC, Belmain SR. Efficacy of *Strychnos spinosa* (Lam.) and *Solanum incanum* L. aqueous fruit extracts against cattle ticks. Trop Anim Health Pro. 2013;45:1341-7.
93. Magadula J, Innocent E, Otieno J. Mosquito Larvicidal and Cytotoxic Activities of 3 Annona species and Isolation of Active Principles. J Med Pl Res 2009;3(9):674-680.
94. Mahae N, Chaiseri S. Antioxidant activities and antioxidative components in extracts of *Alpinia galanga* (L.) Sw. Kasetsart J Nat Sci. 2009;43:358-369.
95. Mahmood N, Pizza C, Aquino P, De Tommasi N, Piacente S, Colman S. Inhibition of HIV infection by flavanoids. Antiviral Research. 1993;22:189-199.
96. Mahmood I, Imadi SR, Shazadi K, Gul A, Hakeem KR. Effects of Pesticides on Environment. In: Hakeem, K., Akhtar, M., Abdullah, S. (eds) Plant, Soil and Microbes. Springer, Cham; c2016. https://doi.org/10.1007/978-3-319-27455-3_13
97. Malonza MM, Dipeolu OO, Amoo AO, Hassan SM. Laboratory and field observations on anti-tick properties of the plant *Gynandropsis gynandra* (L.) Brig. Vet Parasitol. 1992;42:123-36.
98. Manivannan J, Silambarasan T, Shanthakumar J, Suganya N, Kanchana S. Role of Antioxidants in Human Health. In Omega-3 Fatty Acids, 2016, 501-512 Springer.
99. Manukumar HM, Shiva Kumar J, Chandrasekhar B, Raghava S, Umesha S. Evidences for diabetes and insulin mimetic activity of medicinal plants: Present status and future prospects. Critical Reviews in Food Science and Nutrition. 2017;57(12):2712-2729.
100. Mathius-Mundy M. Ethnoveterinary medicine: harnessing its potential. Vet Bull 2004;74(8):27N-37N.
101. Mbaya YP, Yahi D, William A. Abortifacient Effects of Aqueous Leaf Extract of Annona senegalensis Pers in Albino Rats. Continental J. Applied Sciences 2019;14(2):68-77 DOI: 10.5281/zenodo.3524825
102. Mechineni ADS, Kommuru S, Gujja JA, Mosjidis JE, Miller JM, Burke A, *et al*., Terrill. Effect of fall-grazed sericea lespedeza 1382 (Lespedeza cuneata) on gastrointestinal nematode infections, skin and carcass microbial load, and meat quality of growing goats. Vet. Parasitol. 2014;204:221-228.
103. Meda NR, Fraisse D, Gnoula C, Vivier M, Felgines C, Senejoux F. Characterization of antioxidants from *Detarium microcarpum* Guill. et Perr. leaves using HPLC-DAD coupled with pre-column DPPH assay. European Food Research and Technology, 2017;243(9):1659-1666.
104. Mensah M, Komlaga G, Forkuo AD, Firempong C, Anning AK, Dickson RA. Toxicity and safety implications of herbal medicines used in Africa. Herbal Med. 2019;63:1992-849. doi: 10.5772/intechopen.72437
105. Monier MA. Traditional medicinal plants of Nigeria: an overview. Agriculture and Biology Journal of North America. 2016;7(5):220-247 doi:10.5251/abjna.2016.7.5.220.247
106. Moyo B, Masika PJ. Tick control methods used by resource-limited farmers and the effect of ticks on cattle in rural areas of the Eastern Cape Province. South Africa Tropl Anim Health Pro. 2009;41(4):517-23.
107. Mubashir N, Fatima R, Naeem S. Identification of novel phyto-chemicals from Ocimum basilicum for the treatment of Parkinson's disease using in silico approach, Curr. Comput. Aided Drug Des. 2020;16:420-434, https://doi.org/10.2174/1573409915666190503113617.
108. Mukherjee PK, Banerjee S, Biswas S, Das B, Kar A, Katiyar CK. *Withania somnifera* (L.) Dunal - modern perspectives of an ancient Rasayana from Ayurveda. J Ethnopharmacol. 2021;264:113157.
109. Negessa T, Bersisa K, Yacob H, Getachew A, Asfaw D. *In vivo* acaricidal efficacy of *Eucalyptus globulus* and *Cymbopogon citratus* against *Sarcoptes scabiei* var caprea of goats. Addis Ababa university Msc thesis; c2011.
110. Newbold LK, Burthe SJ, Oliver AE, Gweon HS, Barnes CJ, Daunt F, *et al*. Helminth burden and ecological factors associated with alterations in wild host gastrointestinal microbiota. ISME J. 2017;11:663-675.
111. Ngulde SI, Sandabe UK, Hussaini IM. Ethnobotanical survey of anticancer plants in Askira/Uba local government area of Borno State, Nigeria. African Journal of Pharmacy and Pharmacology 2015;9(5):123-130.
112. Nimbalkar SD, Patil DS, Deo AD. Ethnoveterinary practices (EVP) for control of ectoparasite in livestock. Indian Journal of Traditional Knowledge 2020;19(2):401-405
113. Njoga UJ, Jaja IF, Onwuka OS, Ilo SU, Eke IG, Abah KO, *et al*. Reproductive Effects of Medicinal Plant (*Azadirachta indica*) Used as Forage and for Ethnoveterinary Practices: New Insights from Animal Models. Challenges. 2022;13:40. https://doi.org/10.3390/challe13020040
114. Nweze NE, Ogidi A, Ngongeh LA. Anthelmintic potential of three plants used in Nigerian ethnoveterinary medicine. Pharm Biol 2013;51(3):311-315.
115. Nyahangare ET, Mvumi BM, Mutibvu T. Ethnoveterinary plants and practices used for ecto-parasite control in semi-arid smallholder farming areas of Zimbabwe. Journal of Ethnobiology and Ethnomedicine. 2015;11:30 DOI 10.1186/s13002-015-0006-6.
116. Ogbuew IP, Okechukwu KC, Emenalom OO, Okoli IC. Diversity of Plants Used in Animal Reproduction in Enugu State. Global Journal of Animal Scientific Research. 2015;3(4), 685- 694.
117. Okhale SE, Akpan E, Fatokun OT, Esievo KB, Kunle OF. Annona senegalensis Persoon (Annonaceae): A review of its ethnomedicinal uses, biological activities and phytocompounds. Journal of Pharmacognosy and Phytochemistry. 2016;5(2):211-219.
118. Okoye T, Akah P, Omeje E, Okoye F, Nworu C.

Anticonvulsant effect of kaurenoic acid isolated from the root bark of Annona senegalensis. Pharmacol Biochem Behav. 2013;109:38-43.
119. Olugbuyiro JAO, Moody JO, Hamann MT. Inhibitory activity of *Detarium microcarpum* extracts against hepatitis C virus. African Journal of Biomedical Research. 2009;12(2):149-151.
120. Oluyemi KA, Okwuonu UC, Baxter DG, Oyesola TO. Toxic effects of methanolic extract of Aspilia africana leaf on the estrous cycle and uterine tissues of Wistar rats. International Journal of Morphology. 2007;25:609-614.
121. Omotayo FO, Borokini TI. Comparative phytochemical and ethnomedicinal survey of selected medicinal plants in Nigeria. Scientific Research and Essays. 2012;7(9):989-999.
122. Ouachinou JMAS, Adomou AC, Dassou GH, Yedomonhan H, Tossou GM Akoegninou A. Connaissances et pratiques ethnobotaniques en médecines traditionnelles vétérinaire et humaine au Bénin: similarité ou dissemblance? J. Appl. Biosci. 2017;113:1174-1183.
123. Ozioma E, Okaka A. Herbal medicines in African traditional medicine. doi:10.5772/intechopen.80348. 2019.
124. Pal RS, Ariharasivakumar G, Girhepunje K, Upadhyay A. *In vitro* antioxidant Activity of phenolic and flavonoids compounds extracted from seeds of *Abrus precatorius*. Int J Pharm Pharm Sci. 2009;1:136-140.
125. Pan SY, Zhou SF, Gao SH, Yu ZL, Zhang SF, Tang MK, *et al*. New Perspectives on How to Discover Drugs from Herbal Medicines: CAM's Outstanding Contribution to Modern Therapeutics eCAM; c2014. ID 627375.
126. Patoliya P, Raval K, Upadhyay VR, Dewry R, Maiti S, Mondal G, *et al*. Tick infestation and its herbal treatment approach in India: A review. 2022;11:1323-1339.
127. Patra AK, Saxena J. Dietary phytochemicals as rumen modifiers: A review of the effects on microbial populations. Antonie van Leeuwenhoek. 2009;96:363-375.
128. Pawa SR, Jain A, Sharma P, Chaurasiyah PK, Singour PK. *In vitro* Studies on Sida cordifolia Linn for Anthelmintic and Antioxidant Properties. Chinese Medicine. 2011;2:47-52 doi:10.4236/cm.2011.22009
129. Perumal P, Veeraselvam M, Nahak AK. Herbal Treatment in Animal Reproduction. International Journal of Bioresource and Stress Management. 2013;4(3):460-467.
130. Ponnusamy K, Kale RB, Ravi KN, Devi MA, Sharma P. Cross-regional analysis on usage of Indigenous Technical Knowledgein dairy farming. Indian J Anim. Res. 2016;51:549-556.
131. Qi H, Wang WX, Dai JL, Zhu L. *In vitro* anthelmintic activity of *Zanthoxylum simulans* essential oil against Haemonchus contortus. Veterinary Parasitology. 2015;211:223-227.
132. Rajkumar R, Srivastava SK, Varshney VP, Mahmood S. Effect of medicinal plants Saraca asoca and Trigonella foenum- graecum in anestrus cows. Indian Veterinary Journal. 2008;85:1281-1283.
133. Ramadan G, Al-Kahtani MA, El-Sayed WM. Anti-inflammatory and anti-oxidant properties of Curcuma longa (Turmeric) versus Zingiber officinale (Ginger) rhizomes in rat adjuvant-induced arthritis. Inflammation. 2011;34:291-301.
134. Ramdani D, Yuniarti E, Jayanegara A, Chaudhry AS. Roles of Essential Oils, Polyphenols, and Saponins of Medicinal Plants as Natural Additives and Anthelmintics in Ruminant Diets: A Systematic Review. Animals. 2023;13:767. https://doi.org/10.3390/ ani13040767
135. Rautela R, Das GK, Khan FA, Prasad S, Kumar A, Prasad JK, *et al*. Antibacterial, anti-inflammatory and antioxidant effects of A. marmelos and M. koenigii in dairy cows with endometritis. Livestock Science. 2018;214:142-148.
136. Dutt R, Dalal J, Singh G, SC, Gahalot Chandolia RK. Medicinal Uses of *Murraya koenigii* and Aegle marmelos for Fertility Augmentation in Animals: A Review. Int. J. Curr. Microbiol. App. Sci. 2018;7(09):645-657 doi: https://doi.org/10.20546/ijcmas.2018.709.077
137. Rochfort S, Parker AJ, Dunshea FR. Plant bioactives for ruminant health and productivity. Phytochemistry. 2008;69:299-322.
138. Sadiq MB, Syed-Hussain SS, Ramanoon S, Saharee A, Ahmad N, *et al*. Knowledge, attitude and perception regarding antimicrobial resistance and usage among ruminant farmers in Selangor, Malaysia. Prev. Vet. Med. 2018;156:76-83.
139. Saftri AD, Hamid IS, Hastutiek P, Koesdarto S, Sugihartuti R, Suprihati E. The anthelminthic activity of ethanol extract of bitter leaf (*Vernonia amygdalina*) against *Ascaridia galli* worm *in vitro*. J Parasit Sci. 2019;3(1):19-22.
140. Saleh H, Azizollah J, Ahmadreza H, Raham A. The Application of Medicinal Plants in Traditional and Modern Medicine: A Review of Thymus vulgaris. International Journal of Clinical Medicine. 2015;06:635-642. 10.4236/ijcm.2015.69084.
141. Sarwar M. Microbial insecticides: An eco-friendly effective line of attack for insect pest's management. The International Journal of Engineering and Advanced Technology. 2015;2:4-9.
142. Ullah S, Ullah R, Shakir L, Ullah R. Cheek list of ethno botanical plants of tehsil colony, Samarbagh, District Dir lower, Khyber Pakhtunkhwa Pakistan. Int. J Agric. Nutr. 2021;3(1):41-49.
DOI: 10.33545/26646064.2021.v3.i1a.63
143. Semde Z, Koudou J, Zongo C, Somda MK, Figueredo G, Ganou L, *et al*. Chemical composition, antioxidant and antimicrobial activities of the essential oil of *Detarium microcarpum* Guill. and Perr. leaves from Burkina Faso. International Journal of Pharmaceutical Science Research. 2018;9:956-964.
144. Shai K, Lebelo SL, Ng'ambi JW, Mabelebele M, Sebola NA. A review of the possibilities of utilizing medicinal plants in improving the reproductive performance of male ruminants, All Life. 2022;15(1):1208-1221, DOI: 10.1080/26895293.2022.2147225
145. Shekarchi M, Hajimehdipoor H, Saeidnia S, Gohari AR, Hamedani MP. Comparative study of rosmarinic acid content in some plants of Labiatae family, Phcog. Mag. 2012;8:37.
146. Shepherd A, Brunckhorst O, Ahmed K, Xu Q. Botanicals in health and disease of the testis and male fertility: A scoping review. Phytomedicine. 2022;106:154398 https://doi.org/10.1016/j.phymed.2022.154398
147. Sindhu ZUD, Igbar Z, Khan MN, Jonsson NN, Siddique M. Documentation of ethno-vetrinary practices used for treatment of different ailments in a selected hilly area of Pakistan. 201x Int J Agr Biol. 2010;2:353-8.

148. Singh J, Kakkar P. Anti-hyperglycemic and antioxidant effect of Berberis aristata root extract and its role in regulating carbohydrate metabolism in diabetic rats. J Ethnopharmacol. 2009;123(1):22-26.
149. Sola P, Mvumi BM, Ogendo JO, Mponda O, Kamanula JF, Nyirenda SP, *et al*. Botanical pesticide production, trade and regulatory mechanisms in sub-Saharan Africa: making a case for plant-based pesticidal products. Food Secur. 2014;6:369-384. http://dx.doi.org/10.1007/s12571-014- 0343-7
150. Stefanidesova K, Skultety L, Sparagano OAE, Spitalska E. The repellent efficacy of eleven essential oils against adult Dermacentor reticulatus ticks. Ticks TickBorne Dis; c2017. http://dx.doi.org/10.1016/j.ttbdis.2017.06.003.
151. Stevenson P, Simmonds M, Belmain S. Caesalpinioid woodlands of Southern Africa: Optimizing the use of pesticidal plants. Chatham: Southern African Pesticidal Plants (SAPP) Project. Final Technical Report. Natural Resources Institute, University of Greenwich; c2010.
152. Suleiman MM, Ogah IJ, Okobia B, Adeyemi OA, Olatunji KT, Ige IM. A review on the antibacterial properties of extracts from Psidium spp and the effects of the extraction solvents. Pakistan Journal of Medicine and Dentistry 2016;5(3):47-56.
153. Talukdar DJ, Shyam J, Talukdar Papori, Ahmed K, Gogoi R. Documentation of traditional herbal medicines for reproductive disorders of livestock in Kamrup District of Assam. Int. J Agric. Sci. Res. 2015;5(6):221-228.
154. Thiruppathi S, Ramasubramanian V, Sivakumar T, Thirumalai Arasu V. Antimicrobial activity of *Aloe vera* (L.) Burm. f. against pathogenic microorganisms. The Journal of Biosciences Research. 2010;1(4):251-258.
155. Uchenna OE, Emeruwa O, Ezugwu CO, Tchimen M, Ezejiofor M. Antidiabetic activity of the methanol extract of *Detarium microcarpum* Guill and Perr (Fabaceae). Planta Medica. 2014;80(10):804-804.
156. Uleh M, Ikyese C, Ekhuemelo D. Ethnomedical study of plants used by indigenous people of Nyiev and Mbawa Districts, Makurdi, Benue State, Nigeria. GSC Biological and Pharmaceutical Sciences. 2017;01(03):001-011.
157. Umadevi M, Rajeswari R, Rahale CS, Selvavenkadesh S, Pushpa R, Kumar KS, *et al*. Traditional and medicinal uses of *Withania somnifera*. Pharm. Innov. 2012;1:102-110
158. Van Andel T, de Boer HJ, Barnes J, Vandebroek I. Medicinal plants used for menstrual disorders in Latin America, the Caribbean, sub-Saharan Africa, South and Southeast Asia and their uterine properties, a review. J. Ethnopharmacol. 2014;155:992-1000.
159. Van Puyvelde L, Geysen D, Ayonbangira FX, Hakizamungu E, Nshimiyimana A, Kalisa A. Screening of medicinal plants of Rwanda for acaricidal activity. J Ethnopharmacol. 1985;13:209-15.
160. Wafa AA, Manal FE, Manal HH, Shahenda M, Doaa MA, Heba T, *et al*. Green Coffea arabica Extract Ameliorates Testicular Injury in High-Fat Diet/Streptozotocin-Induced Diabetes in Rats. Journal of Diabetes Research. Article ID 6762709; c2020. p. 13 https://doi.org/10.1155/2020/6762709
161. Wang R, Ding Y, Liu R, Xiang L, Du L. Pomegranate: constituents, bioactivities and pharmacokinetics, Fruit, Vegetable and Cereal Science and Biotechnology. 2010;(4)2:77-87.
162. Webb EC, David M. The efficacy of neem seed extract (*Azadirachta indica*) to control tick infestation in Tswana, Simmentaler and Brahman cattle. S Afr J Anim Sci. 2002;32(1):1-6.
163. William A, Sandabe UK, Maina VA, Paul – Bokko B, Shamaki BU, Wiam IM, *et al*. Effects of ethanolic stem bark extract of khaya senegalensis on some sperm parameters in male albino rats. Continental J. Biological Sciences. 2016;9(1):25-35, DOI:10.5707/cjbiolsci.2016.9.1.25.35
164. Wong LF, Lim YY, Omar M. Antioxidant and antimicrobial activities of some Alpinia species. J Food Biochem. 2009;33:835-851.
165. Yakubu OE, Olawale O, Arowora KA. Biochemical Changes in Haematological and Liver Function Parameters in Intoxicated Male Albino Rats Treated with *Hymenocardia acida* Leaves Ethanolic Extract. Insights Biomed. 2017;2:2.
166. Yamssi C, Vincent KP, Noumedem A, Christelle N, Norbert K, Etung K, *et al*. *In vitro* anticoccidial, antioxidant activities and cytotoxicity of *Psidium guajava* extracts. Res. J. Parasitol. 2018:13:1-13.
167. Yang YC, Lee HS, Clark JM, Ahn YJ. Insecticidal activity of plant essential oils against *Pediculus humanus* capitis (Anoplura: Pediculidae). Journal of Medical Entomology. 2004;41:699-704.
168. Zeneida TP, Fernandez SF, Ramos A, Fernandes AAC, Ferreira JLP, Escalona-Arranz CJ. Chemical composition and insecticidal activity of Cymbopogon citratus essential oil from Cuba and Brazil against housefly. Braz. J Vet. Parasitol. Jaboticabal. 2015;24:36-44.
169. Zhang W, Zhang Z, Chen Z, Liang J, Geng Z, Guo S, *et al*. Chemical composition of essential oils from six Zanthoxylum species and their Repellent activities against two stored-product insects. Journal of Chemistry, Article ID 1287362, 7; c2017.
170. Schroeder B, Reilly BK. A comparison between tick species collected in a controlled and control free area on a game ranch in South Africa. J S Afr Vet. 2013;84:1. http://www.scielo.org.za/scielo.php?script=sciarttext&pid=S1019912820130001000009&lng=en&nrm=iso