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The Role of Medicinal Plants in Domestic Animals and Estrus Induction with Particular Reference to *Aegle marmelos* and *Murraya Koenigii*

Anju Kujur*, N. Srivastava, Nancy Jasrotia, Arunpandian J

Division of Animal Reproduction, ICAR-Indian Veterinary Research Institute, Bareilly-243122, Uttar Pradesh, India

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ABSTRACT

Due to malnutrition and inadequate management practices, anestrus is frequently observed in domestic animal species, particularly in rural areas. This financially crippling condition in affected animals can be mitigated using available therapeutic measures. The primary challenges with employing hormones or other medicaments for animal reproductive management are the massive price, lack of rapid assay resources, barely commercially accessible and the requirement for veterinarian care. Therefore, herbal medicines are a good alternative since they are cheap, effective, and socially acceptable and they are often the only option with little side effects. Herbal combinations can have significant beneficial effects due to the synergistic or cumulative effects of their active principles. Plants have a wide spectrum of beneficial effects in their natural state and have immense potential as a source of new medications. Traditional remedies *Murraya koenigii* (curry leaves) and *Aegle marmelos* (*bael*) have been shown to boost reproductive performance in lab rats, anoestrus caprine and bovines.

Introduction

In the coming decades, reproductive problems will continue to be a key stumbling block to maximising livestock production. In India, anoestrus is among the most widespread and challenging reproductive disorders in sheep and cattle, lowering reproductive potential, and causing major economic loss to small and marginal farmers and even the dairy industry world in general. Anoestrus has been documented in cattle in India ranging from 25% to 67% (Singh et al., 2003; Pandit, 2004). Rural areas still have a higher percentage of anoestrus, owing to malnutrition and poor treatment. It is a reproductive physiological cycle defect marked by the absence of significant oestrus indications, exhibited either by a paucity of oestrus expressiveness or a failing to identify oestrus. Various treatment agents, both hormonal and non-hormonal, have been used to address this condition, but most synthetic medications

*Corresponding author.
E-mail address: anjikujur007@gmail(Anju Kujur)
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have become unsatisfactory to dairy farmers due to high costs and uneven results. As a result, people are paying more attention to herbal formulations. Various medicinal herbs are now being advertised as cheaper, more effective and safer alternatives to more expensive hormones in the treatment of various reproductive diseases in livestock (Khade et al., 2011).

Since ancient times, India has been the repository of a significant number of herbal medicines. Plants with medicinal properties are used to treat a variety of ailments and problems in humans and other animals. In Rigveda, there is description of many medicinal plants which have been successfully used in treatment of anoestrus. Several phytochemicals widely distributed in plants, including such alkaloids, glycosides, terpenes, and tannins (secondary metabolites) and possess medicinal benefits. Numerous plants are rich in many nutrients, and several of them have estrogen mimicking properties which helps anoestrus animals to restore cyclicity. Many plants, including *Abroma augusta* (Ulatkambal), *Saracaasoca* (Ashoka), *Trigonellafoenum–graecum* (Methi), *Bambusaaruninacea, Carica papaya, Asparagus recemosus, Leptadenia reticulate, Courupitaguianesis, Pergulaciadaemia, Semecarpus anacardium cucumber*, *Murraya koenigii* (curry leaves), *Nigella sativa* (kalonji), *Aegle marmelos*, and jute plants have indeed been supplied to anoestrus animals with varying responses to induction of oestrus, alone or in combinations (Kabir et al., 2001; Das et al., 2002; Mehrotra, 2002; Mishra et al., 2002; Rajkumar et al., 2008; Kumar and Punniamurthy, 2009).

Aegle marmelos and *Murraya koenigii* of Rutaceae family are two known colloquially plants as *curry* and *bael,* documented in the traditional system of medicine in India have many pharmacological properties and therapeutic effects. According to the researchers (Morabad, 2009; Janarthanan et al., 2012; Bhandari, 2012) the plants contain high in antioxidants, minerals (Co, Cu, Fe, I, Mn, Se, Zn) and vitamins (vit A, B, C, and E). In agreement, several investigators have used them independently for augmentation of reproduction in laboratory animals (Satheshkumar and Punniamurthy, 2005; Jhondhale et al., 2009).

Murraya Koenigii has been proven to enhance ovarian reserve in rats, as well as a positive therapeutic outcome in acyclic goats and cattle in aspects of oestrus and conception (Mehrotra, 2002). *Murraya koenigii* was found to be 80 % efficacious in the management of repeat breeding in dairy animals (Hegde et al., 2002). The leaves of plants also show a characteristic of antibacterial, antioxidant and anti-inflammatory properties, thus having significant positive result in the treatment of the endometritis *(*Rautela et al., 2018*)*. Oestrus induction in large animals is aided by the leaves of *Aegle marmelos*. Jondhale (2007) investigated the effect of *Aegle marmelos* in rats, finding that it greatly advances puberty onset. Therefore, the present study reveals role of different plants in the augmentation of heat in anoestrus cow with special reference of *Murraya* and *Aegle* plants.

Application of various plants or their extracts for the induction of oestrus

The alternative medicine, herbal plants such as cucumber leaves, *Saraca asoca, Trigonella foenumgraceum, Leptadenia reticulate, Asparagus racemosus, Couroupitaguianesis*, unripe papaya, *Aegle marmelos* and the like can effectively cure anestrum (Perumal et al., 2013). Many researchers, notably Tomar (1995), found that supplementing indigenous plants, such as fenugreek seeds, also known as maethi, resulted in improved reproductive performance due to the availability of certain minerals (Fe, Ca and P; trace minerals like Mn, Cu & Zn). Berhane (2000) found that supplementing dairy cows with jaggery, linseed oil and fenugreek formulations resulted in the beginning of oestrus as well as an enhanced conception rate. Ahmed (2009) also reported improved reproductive performance when fed at dose rate of 1gm/kg body weight. In addition, *Asparagus racemosus* was thought to improve ovarian function and uterine tonicity, resulting in early uterine involution and oestrous cycle initiation, which was linked to the availability of estrogenic properties (Pandey et al., 2005; Kumar et al., 2010). Prepartum nourishment of *Asparagus racemosus* root powder (PREPOS) for 50 to 60 days @100mg/kg body weight, continued by postpartum dosage (90 days) @200 mg/kg of body weight in medicated cows, oestrous behaviour improved (Kumar et al., 2010). Investigators observed that the feeding of powder of *Saraca asoca* leaves @130 gm for 24 days induced postpartum oestrus in buffaloes. Leaves of *Saraca asoca* contain alkaloids, steroids, flavonoids, tannins, saponins, terpenoids, polyphenolics, glycosides & carbohydrates. *Saraca asoca* leaves have been shown to possess flavonoids such as quercetin, beta-sitosterol and ceryl alcohol. *Saraca asoca* reported to possess the steroidal substance -sitosterol, which exhibits estrogenic effect when combined with calcium salt (Rajkumar et al, 2008; Priyadarshini et al., 2021). Bamboo and jute plant leaves, as well as mann tree leaves, at dosage rate of the 2-2.5 kg and 15-20 kg, respectively help in the induction of the oestrus in the cattle (Gupta, 1993). The leaves of the silk cotton tree are dusted with

fermented boiling rice water and delivered to cows orally as a therapy for reproductive issues. It was advocated that a dose of around 500 ml of the prepared mixture be provided three times a day for three days (Ranjan and Sethuraman, 1997). Another study found that if a heifer was fed 200 g of germinated Bengal gramme (*Cicer arietimun*) every day for a week, the heifer would develop heat symptoms (Perumal et al., 2013). When the aforesaid feeding was supplemented with pounded leaves and unripe fruit of yaanai nerungi (Pedalium murex) fed once a day for three days without adding water, somewhat better results were seen (Perumal et al., 2013). For anoestrus cows, oral feeding of 200 g of germinated horse gramme constantly for one week was also recommended (Balasundaram, 1998). Various parts of the plants are being used as follicle promoter and oestrus treatment in animals (Table 1).

Murraya koenigii and *Aegle marmelos*

Habitat and distribution

Murraya koenigii is a genus of Asian and Australian shrubs and small trees. Curry leaves, also recognized as Indian curry leaf plants, are renowned for their unique aroma and medicinal properties. The bael tree, also known as *Aegle marmelos*, is a native of India's Eastern Ghats and central plains. The bael tree is unique to India, and it can be spotted in Central and South Asia from the Himalayas to West Bengal.

Phyto-constituents

Phyto-constituents of *Murraya koenigii* and *Aegle marmelos* are shown in Table 2 and 3, respectively.

Pharmacological properties

Pharmacological properties of *Murraya koenigii and Aegle marmelos* are summarized in Table 4 and Table 5, respectively.

Medicinal uses of *M. koenigii* and *A. marmelos* in anoestrus

Jondhale (2007) studied the impacts of *Aegle marmelos* in rats, revealing that eating the leaves advances puberty greatly and results in greater ovarian and uterine weight, large surface follicles, and amount of ovulations. It's used to treat an animal like placental retention, repeated oestrus in cows and buffaloes, vaginal haemorrhages, orchitis, and milk fever. The use of leaf to induce oestrus in large animals is common. The leaves of *A. marmelos* were fed to rats, which significantly used in delayed puberty and resulted in higher ovarian and uterine weight, larger surface follicles and more ovulations.

Table 1. Plants which promote follicle growth and oestrus in cattle.

Plant	Part used	Reference
Ficus elastica	Whole plant	Ngeh et al.,1995
Bhalima (Semecarpus anacardium)	Seeds and fruits	Bechardas, 1992
Jute Plant, Bamboo tree, Mann tree	Leaves	Gupta, 1993
Silk cotton tree with fermented rice	Leaves	Ranjan and Sethuraman, 1997
Fenugreek	Seeds	Tomar, 1995; Berhane, 2000; Ahmed, 2009
Aloes barbadensis and *Aristolochiabracteate*	Whole plant	Jayakumar, 1997
Abroma augusta	Root	Kabir et al., 2001
Nigella Sativa	Seed	
MurrayaKoenigii	Leaf	Mehrotra, 2002
Urtica dioica	Root	
Cucumber	Leaves	Chander and Mukherjee, 1994
Asperagus recemosus	Whole plants	Pandey et al., 2005; Kumar et al., 2010
Dudheli (Pergulariadaemia)	Pods	Parmar, 1998
Saraca asoca	Leaves	Rajkumar et al., 2008
Hybanthusenneaspermum	Plant paste	Sudarsanam et al., 2008
MurrayaKoenigii	Leaf paste	

(Table continued)

(Table continued)

Plant	Part used	Reference
Potentilla fulgens	Entire plant	Syiem et al., 2009
Trichoxanthustricuspidate	Boiled unriped fruits	
Brideliaferrugiana	Whole Plants	Ngeh et al.,1995
Ficus elastica	Whole plants	
Gardenia ternifolia	Whole plants	

Table 2. Constituents present in different parts of *Murraya koenigii*

Plant part	Constituents
Leaf	Protein, carbohydrate, minerals, fibre, Vitamin C, Vitamin A, carotene, nicotinic acid, calcium, oxalic acid carbazole alkaloids, koenigin, crystalline glycosides, girinimbin, iso-mahanimbin, koenine, koenidine, koenimbine, triterpenoid alkaloids cyclomahanimbine and tetrahydromahanimbine. Free amino acids such as asparagines, glycine, serine, aspartic acid and glutamic acid
Fruit	Minerals 1.97%, phosphorus, 0.082%, potassium 0.811%, calcium 0.166%, magnesium 0.007%
Bark	Murrayacine, murrayazolidine, murrayazoline, mahanimbine, girinimbine, koenioline, and xynthyletin (Bonde et al., 2011).

Table 3. Constituents present in different parts of *Aegle marmelos*

Plant part	Constituents
Leaves	Skimmianine, Aeglin, Rutin, β-sitosterol, γ-sitosterole, Flavone, Cineol, Citral, Lupeol, O-isopentenyl, Glycoside, Hallordiol, Mameline, Citronellal, Cuuminaldehyd ephenylethylecinnamamides, Euginol, Marmesinin, Aegelin, Glycoside
Fruit	Marmelosin, Aurapten, Luvangetin, Psoralen, Marmelide, Tannin, Phenol
Bark	Fagarine, Marmin, Furoquinoline, Alkaloids
Seed	Essential oil- D-limonene, A-D-phellandrene, Cineol, Citronellal, Citral, P-cyrnene, Cumin aldehyde
Root	Alkaloid, Halopine, Coumarins, Terpines

Table 4. Pharmacological uses of different parts of *Murraya koenigii*

Plants parts	Pharmacological uses	Reference
Leaf	Antibacterial, antifungal, antioxidants, antiinflammatory, antidiabetic, antianxiety and antidepressant, hepatoprotective, cytotoxicity, anticancer (breast, oral), promoting fertility, endometritis, neuroprotective and immunomodulator	Nalli et al., 2016; Arun et al., 2017; Sharma et al., 2017; Tripathi et al., 2018; Rautela et al., 2018
Stem, bark, root	Anticancer (Ovarian), antiinflammatory, antioxidants, cytotoxicity	Iman et al., 2017; Xin et al., 2018

Table 5. Pharmacological uses of different parts of *Aegle marmelos*

Plants Parts	Pharmacological uses	Reference
Leaves	Antiinflammatory, promoting fertility, endometritis, laxative, asthma, opthalmia and eye affection, expectorant, cold and respiratory infection, backache, abdominal disorder, vomiting, cut and wounds, dropsy, beriberi, weakness of heart, cholera, diarrhea, cardiac tonic, control blood sugar, nervous disorders, hair tonic, acute bronchitis, veterinary medicine for wound healing, antiworms, stimulation of respiration.	Patel et al., 2012
Root Bark	Intermittent fever and fish poison, palpitation, melancholia, antidog bite, gastric troubles, heart disorders, fever, antiamoebic, hypoglycemic, rheumatism.	
Flower	Stomach tonic, antidysenteric, antidiabetic, diaphoretic and as a local anesthetic, epilepsy and as an expectorant.	
Fruits	Dysentery, diarrhea, gastric troubles, constipation, laxative, digestive, stomachic, brain and heart tonic, ulcer, antiviral, treatment of rectum inflammation, antiviral, sweet, cooling, aromatic, nutritive, dysentery, astringent, dysentery, stomachache in diarrhea, tonic, digestive, demulcent.	
Seeds	Antibacterial, antifungal	

Murraya koenigii, alone or in conjunction with a mineral combination and a small dose of GnRH injection, was similarly efficient in initiating fertility in anoestrus buffaloes (Umashanker et al., 2006). *M. koenigii* leaves were used to remedy repeat breeding in dairy cows and were found to be 80% efficacious (Hegde et al., 2002). It has been observed that *M. Koenigii* has the potential to strengthen ovarian function in rats, as well as boosting therapeutic response in acyclic goats and calves in terms of oestrus and conception (Mehrotra, 2002). The oral administration of *M. koenigii* @500mg/Kg body weight to female Wister albino rats aged 20-70 days produces a rise in the mean age of puberty and perhaps a spike in the proportion of surface follicles on both ovaries, which is due to phytoestrogen in the methanolic extract of *M. Koenigii* (Nandini et al., 2010). A 50% ethanolic extracts of *A. marmelos* @1000 mg/kg body weight resulted in considerably greater uterine weight, surface follicles, and serum oestrogen concentrations in the same adult group of rats. The plant extract significantly increased the frequency of ovulations and blood progesterone levels in treated mice, indicating that it had a beneficial impact. *A. marmelos* was found to have the capacity to advance ovarian function in rats (Jondhale et al., 2009).

Similarly, Sathesh Kumar and Punniamurthy (2005) found that feeding rural crossbred heifers 100g of *M. koenigii* leaves every day for 30 days stimulates oestrus in 60% of the animals and even an elevated serum calcium and phosphorus content. *Murraya* therapy alone culminated in oestrus expression in 50 percent (4/8) of anoestrus buffaloes, with 50 percent conception occurring 15.25 days after therapy ended (Umashanker et al., 2006). Additionally, Kumar (2008) observed oestrus induction (42.8%) in anoestrus buffaloes with a timeframe of 10.0±2.00 days after the conclusion of therapy, with 100% (3/3) conception following *Aegle* treatment. 85.71 percent (6/7) of acyclic goats treated with *M. koenigii* and *A. marmelos* had oestrus induction at a mean interval of 5.33±0.60 days after the date of medication (9 days), with 83.33 percent (5/6) conceiving in the same oestrus (Dutt et al., 2010). After 18.66 ±2.18 days from the date of therapies with *M. koenigii*, Mehrotra et al. (2002) identified 50% oestrus induction in acyclic goats, whereas the Kumar et al. (2008) found 57.14 percent oestrus induction (61.1 percent) and conception throughout all animals after 15 days of the end of therapies with *A. marmelos.* Dutt et al. (2012) revealed that even after medication with *M. koenigii* and *A. marmelos* mixture, the mean value of triiodothyronine was greater (P0.05) on days 8, 12, and 16 (1.78±0.06, 2.32±0.20, and 2.10±0.28) compared to untreated (1.24±0.33, 1.03±0.15, and 1.09±0.20ng/ml) in acyclic goats. Increased peripheral thyroid hormone levels (P>0.05) and return of cyclicity (60%) between days 8 and 16 after medication imply that tri-iodothyronine and thyroxine may be metabolic signals signalling the start of the ovarian cycle. Dutt et al., 2011 found that feeding both Murraya and Aegle leaves simultaneously resulted in 60 percent inducement of oestrus in anestrus buffalo. Effectively using the dose-equivalent approach, 50 percent ethanolic extract doses of both plants were extrapolated from rats (1000 mg/kg) to buffaloes and transformed into powder form based on per-cent yield. The final doses were made by combining half of the predicted doses of each plants based on body weight. As according Dutt et al. (2011), in delayed pubertal buffalo heifers, the rate of expansion of large follicles was faster (P0.05) in herbs medicated (0.55 mm/day) than in control (0.25 mm/day), and it has been stated that fortification of *A. marmelos* and *M. koenigii* can influence the growth processes of large follicles by achieving dominance, accelerated growth rate, pre-ovulatory (Kumar et al., 2016). Kumawat et al. (2016) also revealed that while both herbs were nourished for 9 days in farm and field conditions, the oestrus induction response in delayed pubertal heifers was expanded by 80-90 percent and fertility effectiveness was improved. The estimated time between the start of the herbs therapies and the onset of behavioural oestrus varied between 11.25±1.91 and 24.9±4.76 days. It was further corroborated by Das et al., 2016, who found that 26 (86.70 percent) of 30 treated rats aged 22-48 months and weighing 200-300 kg exhibited oestrus-like behaviour. When *M. koenigii* and *A. marmelos* were used together, the induction of oestrus was higher than when *M. koenigii* and *A. marmelos* were used separately.

Conclusion

Since application of ethnoveterinary techniques in veterinary therapeutics lacks enough scientific validation, this review attempts to findings in the field for legitimacy and validation among practitioners. *Murraya* and *Aegle* therapy restored considerable fertility in anestrus animals in aspects of estrus, ovulation and pregnancy establishment. As a consequence of the herbal approach to such circumstances, it's probable that gonadotropins from the anterior pituitary or other active components mimicking them launched follicular dynamics by increasing follicular recruitment, selection and reducing follicle atresia. This review emphasises that combination medicines have a higher effectiveness in anestrus animals and even the possibility of synergism, than previously explored individual plant treatments.

Conflict of interest

No conflict of interest declares.

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