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TWO NOVEL PROPERTIES OF ARECANUT, *Areca catechu* L. - PESTICIDAL AND FUNGICIDAL PROPERTIES: A COMPILATION

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Areca catechu L. (family: Arecaceae) is a palm mainly grown in tropical and subtropical climate of the world. The major growing areas are South and South East Asian countries such as India, Bangladesh, Indonesia, Myanmar, China, Thailand, Sri Lanka, Bhutan, Nepal, Pakistan, Malaysia, Philippines, Vietnam, Afghanistan, etc. (Balasimha and Rajagopal, 2004). It has a solitary, slender (about 50cm circumference), straight trunk growing up to 30m tall with a tuft of 7-12 pinnate leaves (1.2 to 1.8m long) at the crown. The leaf consists of a middle rachis with numerous leaflets (30 to 60 cm long) on both sides and a boat shaped sheath (about 50cm in length and 15cm in breadth) at the proximal end completely encircling the stem to protect the growing inflorescence. The inflorescence is a short- stalked spadix with numerous rachillae. The fruit is a drupe with one seed or endosperm covered with a thin husk or pericarp which is green in color when unripe and yellow or orange when ripe. Fruits are of various sizes (30-40cm diameter) and shapes (round, oval or oblong). The endosperm, which is commonly called as arecanut or 'supari', is reddish brown in color with dark wavy lines and a central white core or pith (Ananda, 2004). The nut is misnamed as betel nut in certain parts of the world as it is generally chewed along with the leaf or inflorescence of a perennial vine called *Piper betle* (IARC, 2004).

India accounts for more than 50% of the world production of arecanut followed by China, Malaysia, Indonesia, Vietnam, Philippines and Thailand (Cherian and Kumar, 2014). Arecanut is generally marketed after processing. One type of processing is done by drying of ripe fruits for 40-45 days under sun, dehusked and marketed as 'White Supari'. Another type of processing is by boiling unripe dehusked nuts, either as whole nuts or after slicing the kernel, and drying and marketed as 'Red Supari' (Selvan *et al.*, 2004). Since time immemorial, arecanut is being used for chewing along with several other ingredients, as it is believed to have numerous medicinal properties (Aman, 1969; Arjungi, 1976; Jaiswal *et al.*, 2011; Li Shizhen, 2003; Pardo De Tavera, 1901; Peng *et al.*, 2015a; ShankaraBhat, 2008; WHO, 2009). Most of them are now validated with proper scientific evidences (Amudhan, 2005; 2011; Amudhan *et al.*, 2012; KeshavaBhat *et al.*, 2016; 2017a; 2017b; 2017c; 2017d; Patil *et al.*, 2009; Peng *et al.*, 2015b; Rashid *et al.*, 2015).

Plants have rich source of bioactive phytochemicals especially polyphenols which serve as defense against natural pests and diseases (Lattanzio *et al.*, 2006). Arecanut is also having good amount of phytochemicals, including 11.1 - 29.8% polyphenols (mainly tannins and flavonoids), 0.11 - 0.24% alkaloids (arecoline, arecaidine, guvacine, guvacoline,

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etc.), 17.3 - 25.7% polysaccharides, 6.2 - 9.4% proteins, 8.1 -15.1% fats, 8.2 - 15.4% fibres and 1.1 - 2.5% minerals (Shivashankar *et al.*, 1969). The tannin content in the nut decreases with maturity of the nut whereas alkaloid content increases (Mathew *et al.*, 1964). Apart from the medicinal properties of arecanut, there are some reports which say that this palm has certain pesticidal and fungicidal properties too. Such reports are collected, studied and discussed in this paper.

1. Arecanut as pesticide:

1.1. As larvicide:

The extract of arecanut was reported to be larvicidal against certain insects such as mosquitoes, house flies, etc. Anthikat *et al.* (2012) studied the toxicity of four different types of extracts (aqueous, petroleum ether, chloroform and ethanol) of arecanut on the larvae of the house fly, *Musca domestica*; blow fly, *Chrysomya megacephala* and the mosquito, Culex sp. It was found that the ethanol extract of arecanut which possessed many phytochemicals including carbohydrates, alkaloids, glycosides, terpenes, phenolics and tannins was more effective than other types of extracts. Further, it was found that the larvae of *Culex* sp. were more susceptible to the extracts followed by that of *C. megacephala* and *M. domestica* with the LD_{50} of 0.072, 1.86 and 5.88 mg/ml, respectively. According to the authors, the larvicidal activity was attributed to terpenes and phenolics present in the ethanol extract of arecanut. Steam distillation of arecanut yielded only 23.33% mortality in the larvae of *C. quinquefasciatus* at 100 ppm (Poolprasert *et al.*, 2015). Probably, by steam distillation the authors could not extract all the phytochemicals present in arecanut.

The leaf extract of areca palm was also found to be very effective against several mosquitoes. The methanolic extract of the leaves of areca palm at 10% concentration gave 100% mortality in the larvae of the mosquito *Anopheles stephensi* (Vinayagam *et al.*, 2008) and also found very effective against the larvae of *Aedes aegypti* with LC_{50} value of 124.28 ppm and 95.75 ppm at 24 hours and 48 hours, respectively (Tennyson *et al.*, 2012). There are reports which say that the polyphenols (saponins and tannins) and alkaloids are mainly responsible for the larvicidal activities of plants (Jawale, 2014; Tandon and Sirohi, 2010).

1.2. As acaricide:

Mites are small arthropods belonging to the class Arachnida and subclass Acari (also known as Acarina). Several of them are parasitic on human being and his livestock and several others especially the spider mites are pests on different crops.

The acaricidal effect of arecanut was evaluated against the house dust mite, *Dermtophagoides pteronysinus* by directly applying the ethanol extract of *A. catechu* on them at concentrations of 1.0, 0.5, 0.25, 0.125, 0.0625 mg/40µl and exposing the mites for 24 hours (Jung, 2014). It was observed that the concentration of 1.0 mg/40µl of such arecanut extract produced 100% mortality in treated mites. The mortality rate deceased slowly as the concentration reduced. It was 98% at 0.5 mg, 50% at 0.125 mg and 25% at 0.0625 mg/40µl. Hence, arecanut extract could be used as an effective biopesticide in place of commercial

acaricides. The petroleum ether extracts of several traditional Chinese medicines were also reported to be effective in controlling house dust mites (Wu *et al.*, 2010).

1.3. As molluscicide:

Snails and slugs (Molluscicidae) are considered to be the pests of crops as well as carriers of several parasites causing diseases such as fascioliasis, schistosomiasis, etc., to man and his livestock. It was reported that the extract of arecanut is also having good molluscicidal property. The ethanolic extract of the seeds of arecanut was found better than other types of extracts in controlling the fresh water snail *Lymnaea acuminata* with the LC_{50} value of 17.21 mg/l (Jaiswal and Singh, 2008). This molluscicidal action of arecanut was attributed to its active principle arecoline which inhibits the activity of acetylcholinesterase in the nervous tissues (Chen *et al.*, 2007; Jaiswal *et al.*, 2008). Further, the molluscicidal activity of arecanut extract was increased substantially by adding synergistic compounds such as MGK-264 or piperonyl butoxide (PB) which are generally used to enhance the toxicity of synthetic pesticides. With the addition of MGK-264 and PB, the toxicity of arecanut extract against the snail, *L. acuminata* was increased by 1.95 and 2.34 times, respectively at 24 h exposure period than the treatment with areca seed powder alone (Hanif and Singh, 2013).

2. Arecanut as plant fungicide:

Fungal pathogens infest almost all crops and incur heavy loss to farmers. Certain species of fungi also infest fruits and nuts. *Colletotrichum* is one of the common pathogens responsible for early fruit rot in crops especially in mango, grape, banana, guava, chilly, etc. It was reported that arecanut extract is very effective in controlling the mango anthracnose fungus, *C. gloeosporioides*. In a study conducted using different extracts of ripe as well as unripe arecanuts, it was reported that the chloroform extract was better than the hexane and methanol extracts in inhibiting the growth and spore germination of this fungus (Rusdan *et al.*, 2015). Further, in their study, the treatment of mangoes using such arecanut extract was found slightly less effective than the treatment using benomyl, the common fungicide used for the control anthracnose infestation. With arecanut extract the disease infestation was reduced by 34% over control whereas with benomyl it was 47%.

It is interesting to note that the extracts of arecanut pericarp (husk) was found to be more effective than that of the extract of the nuts in reducing the effects of anthracnose disease in mango fruits. In a study on the antifungal activity of the extract of arecanut pericarp against *C. gloeosporioides* it was noticed that the hexane, ethyl acetate and methanol extracts of the pericarp were antifungal (Yenjit *et al.*, 2010). In their study it was also reported that the three triterpenes isolated from the pericarp of arecanut, namely fernenol, arundoin and a mixture of stigmasterol & α-sitosterol and one fatty acid, lauric acid inhibited the mycelia growth of this fungus effectively with EC_{50} values of 36.7, 47.5, 6.7 and 111.5 mg/l, respectively. They also found that all the three triterpenes successfully inhibited spore germination and germ tube elongation and were significantly more effective than benomyl for controlling the post harvest anthracnose disease in mango fruits when used at 100 and 200 mg/l.

Aspergillus niger is a fungus which causes a disease called 'black mould' on certain fruits and vegetables such as grapes, apricots, onions, and peanuts, and is a common contaminant of food. The aqueous extract of arecanut is also reported to be effective against this fungus with the zone of inhibition of 14mm at 16.67 µg/ml (Anthikat *et al.*, 2014). They also found that the arecanut extract was also effective against other fungi such as *Mucor* and *Cladosporium* with zone of inhibition of 12 and 13 mm, respectively at that concentration.

3. Conclusion

Plants have good amount of polyphenols which serve as defense against pests and diseases. Areca palm is not an exception to this. The nuts of this palm contain up to 29.8% polyphenols. Reports confirm that the ethanol extract of arecanut which possess many phytochemicals including carbohydrates, alkaloids, glycosides, terpenes, phenolics and tannins was more effective than other types of extracts in its larvicidal activity against mosquitoes and flies. The LD_{50} for the larvae ranged from 0.072 to 5.88 mg/ml. Areca leaf extract was even found better than its nut extract as larvicide. The ethanol extract of nuts proved to be 100% effective against house dust mite at a concentration of 1.0 mg/40µl and very effective against the fresh water snail *Lymnaea acuminata* with the LC_{50} value of 17.21 mg/l. Not only the extracts of the nut but also the extract of the husk of the nut was found effective in controlling the anthracnose fungus in mangoes with the latter found better than even the benomyl, the common chemical fungicide used for the control of anthracnose infestation at a concentration of 100 and 200 mg/l. Since the extracts of both areca leaf and arecanut husk were found very effective as larvicide or fungicide, there is ample opportunity to utilize them properly. As there is a worldwide awareness to replace the chemical pesticides and fungicides with biological ones, it is high time to utilize these raw materials of areca palm, which are available in plenty, for the synthesis of such compounds and commercialize them. Similar studies should also be carried out against other fungal pathogens and pests for the benefit of mankind.

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