INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2007/09–3–530–532
http://www.fspublishers.org

Mini Review

Exploiting Neem (*Azadirachta Indica*) Resources for Improving the Quality of Life in Taraba State, Nigeria

J.D KABEH AND M.G.D.S.S. JALINGO[1]
Crop Science Department, Adamawa State University, Mubi, P.M.B. 25, Mubi, Adamawa State, Nigeria
[1]Corresponding author's e-mail: kabehdauda@yahoo.com

ABSTRACT

Neem (*Azadirachta Indica.* A. Juss.) plant is grown extensively in the savanna region of Nigeria. Biologically active ingredients of this plant have diverse applications. These compounds belong to the natural products called triterpenoids (Limonoids). The plants provide extensive agro-forestry products. Over 413 insect/pest species are sensitive to neem products, except the oriental yellow scale *Aonidiella orientalis* Newstead (Homoptera: Diaspidae), which threatens survival of neem plantations. Field trials with neem cake stimulate algal growth by suppressing grazers like ostracods (crustacea). Furthermore, neem cake admixed with urea fertilizer significantly improves efficiency of fertilizer utilization and reduces root knot nematode index to zero in tomato fields. Alkali treated neem cake performed significantly better when incorporated into poultry feeds. Several animals and plant pathogenic fungi, bacteria, viral, protozoan and Helminths are sensitive to neem preparations, with antiseptic properties. NSO and leaves extract significantly inhibited fertility in males, but not anti-ovulatory, hence "sensal" a contraceptive.

Key Words: Neem resources; Improvement of quality; Nigeria

INTRODUCTION

The neem plant *Azadirachta. Indica A. Juss.,* Family milliaceae (mahogany) is native of India and Burma and adapted favorably to the sub-sahelian Nigeria with severe drought, poor, shallow and even saline soil. Neem trees occupy above 3,500 ha of land in Kebbi, Sokoto, Borno and Zamfara in Northern Nigeria, with a density of about 1,200 trees per ha (Fujinmi *et al.,* 1990). The fruit yield is variable ranging from 10 - 50 kg per tree with an average of 20 kg (Radwanski, 1977; Schmutterer, 1995). Neem based products have been under-exploited despite abundance of the plant in northern Nigeria.

Biologically active principles isolated from different parts of the plant include: azadirachtin, meliacin, gedunin, salanin, nimbin, valassin and many other derivatives of these principles. Miliacin forms the bitter principles of neem seed oil (NSO), the seed also contain tignic acid (5-methyl-2-butanic acid) responsible for the distincitive odour of the oil (Schmutterer, 1990; NRC, 1992; Uko & Kamalu, 2001; Lale, 2002). These compounds belong to natural products called triterpenoids (Limonoids). The active principles are slightly hydrophilic, but freely lipophilic and highly soluble in organic solvents like, hydrocarbon, alcohols, ketones and esters (NRC, 1992; Schmutterer, 1995).

There has been astronomical increase in the costs of fertilizers, pesticides, animal feeds and drugs in the developing countries, with an increasing indebtedness and acute poverty. This situation exerts enormous pressure to explore local resources handy to combat these deficits and improve quality of life of the people. One of such available resources with great potentials in the 21st century is the neem tree. The objectives of these reviews were to: elucidate the premises of neem for exploitation and utilization; identify formulations of biologically active principles, limitations against wide spread use and possible inherent dangers of neem products.

Environmental conservation (afforestation). In agro-forestry, neem product benefits extended to providing shade, firewood, timber, wind breaks, shelter belt and check against desertification in the semi-arid zone of northern Nigeria. In Nigeria, neem forms about 90% of the trees in the forestry plantations established in the 12 states within the savanna zone under the afforestation programme, Taraba inclusive (Nwokeabia, 1994). In Chad, neem constitutes about 17% of the tree cover (Ohabuike, 1995).

Pest management prospects. The pesticidal activity of neem span a wide spectrum, having repellent, phagodeterrent (antifeedant), insect growth regulatory (IGR), anti-ovipositional, fecundity and fitness reducing properties on insects. Schmutterer and Singh (1995) listed 413 insect pest species sensitive to neem products. These principles act as ecdysteroid analogues, which affect corpus cardiacum and block reproductive and growth processes in most insects causing sterility in females and degenerative changes in male testis due to disturbance in insect metabolism (Krauss *et al.*, 1987). Formulations like: Margosan O$^{(R)}$, Neemix$^{(TM)}$, Azatin$^{(R)}$, NIM-20 and NIM-76, gave negative result with respect to toxicity effect on mammals (Schmutterer, 1990, 97; Govindachari *et al.*, 2000). Hence, Neemix(TM), was registered for use on vegetables in US for its inherent safety. In most tests, neem products performed equally or sometimes better than synthetics like Pirimiphos-methyl (Actellic 25 EC), Permethrin and Lindane (γBHC) (Ogunwolu & Oddunlami, 1996; Lale & Mustapha, 2000).

Furthermore, the oriental yellow scale insects *Aonidiela orientalis* Newstead (Homoptera: Diaspidae) threatens survival of this Jewel in the savanna (Mahmood, 1995), through necrosis, chlorosis and scorching of the whole foliage, as they inject toxic metabolites into the foliage (Matig, 1986).

Neem cake value as fertilizer. Biological nitrogen fixation (BNF) maintains soil nitrogen (N) fertility. Non-symbiotic microorganisms like photosynthetic bacteria and blue green algae (BGA) enhances this process. In field experiments neem cake stimulate algal growth by suppressing the grazers particularly Ostracods (class:crustacea). BGA biomass tripled and N-fixation activity increases by 10 fold (Grant *et al.,* 1983b). The underlying mechanism is acute toxic effect rather than anti-feedant on the Ostracods.

Admixing neem cake with urea fertilizer improves efficiency of fertilizer utilization in crop production by gradual release of nitrogen to crops (Ketkar, 1983). In tomato fields, neem cake significantly reduce root-knot nematode index to zero, with improved growth of tomatoes. The cake inhibited larval emergence and egg hatching. Finally these effects of neem enable exploitation by Indians and other Asians.

Neem seed as animal feeds. Despite the bitter components, live-stocks consume diets containing varied percentage of neem cake. However, nutritional efficiency and feed utilization were not achieved hence severe growth depression and about 50% mortality. Alkali treatment of neem cake with caustic soda (NaOH) yields palatable product, by removing the toxicant triterpinoids (Devakumar & Dev, 1993). Nagalakshmi *et al.* (1996) and Verma *et al.* (1998) reported beneficial effect of alkali treated (10 - 20 g NaOH) neem kernel cake incorporated into poultry feeds, in giving increased feeding value and protein utilization with spectacular growth. No significant difference was observed among the different dietary groups in feed intake, egg production, egg quality, fertility, hatchability and chick weight.

Anti-microbial benefit of neem. Several "active principles" from neem have demonstrated high efficacy, against most pathogens. As fungicides, over 14 common fungi species are sensitive to neem preparations (Khan & Wassilew, 1987) they include the genera *Trichophyton* (athletes foot), *Epidermophyton* (ringworm of skin & nails), *Microsporum* (ringworm of skin & hair) and *Candida* (thrush).

SaiRam *et al.* (1997, 2000) reported protection against systemic candidiasis (C*andida albican*) by NIM-76. The mechanism is simply antifungal and immunomodulatory. In *Aspergillus flavus,* neem leaf extract fail to inhibit growth, but reduce formation of aflatoxin by blocking 'polyketides' production, which is commonly converted to toxins (NRC, 1992). Several diseases including Cercospora, Anthracnose, Downy mildew and Sigatoka are under investigation to establish efficacy of neem products as plant fungicides.

As antibiotics, pathogenic bacteria like *Staphylococcus aureus, Salmonella typhi* are significantly suppressed by NSO. Trials with NIM-76 significantly suppressed *E. coli* and *K. pneumoniea*, which hitherto were insensitive to whole NSO (SaiRam *et al.*, 2000).

As antiviral agents, experiment with Small pox, Chicken pox and Fowl pox viruses show biological efficacy of neem extracts. Crude neem extracts adsorbed the viruses by blocking entry into uninfected cells. NIM-76 suppressed Polio virus replications and inhibited DNA polymerase of Herpes virus with no potency once infection is established *in vivo* (Rao *et al.*, 1989).

Chemotherapeutic effect of neem. In West Africa, India, Burma, etc., both aqueous and alcohol extracts of bark and leaves of neem are effective anti malaria agents, particularly on chloroquine resistant strains (Badam *et al.*, 1987). One active components, 'gedunin' gave significant control as effective as quinine on malaria (Khalid *et al.*, 1989). The mechanism is possibly redox status of red blood cells (RBC) on parasite. The plasmodial parasite generate oxidant, while neem extracts reduced the oxidized cells to destroy the malaria parasite (Anonymous, 1983).

Furthermore, neem bark and leaves posses strong antiseptic property warranting use as active ingredient in tooth paste in India and Germany. While aqueous extract of leaves exhibit laxative potentials by increased bowel movement (Uko *et al.*, 1995), over dose could however produce severe abdominal cramps or rectal prolapse. Kloos and Mc Cullough (1987) reported potency of NSO on snail fever (Schistosomiasis) with the active principle being mulluscicidal, ovicidal and cercariacidal. Several herbalists opined that neem products have broad spectral chemotherapeutic effect on the Flat, Tape and Round worms (Devakumar *et al.*, 1985).

Male antifertility activity. The NSO leaf extracts and NIM-76 act as powerful spermicide and significantly inhibited spermatogenesis, decreased sperm motility, count and cessation of fertility. These conditions were reversed by the withdrawal of neem products 4 - 6 weeks later (Sadre *et al.*, 1983). No significant effect on loss of libido or potency. Furthermore, NSO possess anti-implantation and abortifacient properties. Sinha *et al.* (1984) found spermatozoa of human and Rhesus monkey were immotile and die within 30 min of contact with NSO in an intra-vaginal dose of 1 mL. Vaginal biopsy revealed no side effect, while radio-isotope studies indicate non-absorption in the vagina and non-antiovulatory (Sinha *et al.*, 1984). These findings enabled neem oil formulation 'sensal' use in India as powerful contraceptive.

Mohan *et al.* (1997) reported significant reduction in semen volume, sperm count, higher incidence of morphological abnormalities of spermatozoa, fertilizing ability and hatchability of eggs on birds (cockerel/broilers) fed neem kernel cakes. Although safe in mammals, neem products are potentially toxic to sperm production in birds.

CONCLUSION

Most of these findings are not patented, though potentially valuable, cost effective, reduces incidence of pests and parasite resistance with increase in agricultural production, protection and health care services for humans and livestock. It is inferred from the above that neem plant is indeed a jewel in the Nigerian Sahel savanna. Prompting the establishment of a task force within the Lake Chad Basin Commission (LCBC) in 1990 and "Neem Commission" in 2003 to explore potential uses of neem resources were useful. For adequate benefits, researches on neem must be directed at identification and quantification of the active principles and patenting of findings, making it readily accessible for adoption to improve the quality of life.

REFERENCES

Anonymous, 1993. *In*: Iwu, M.M. (ed.), *Handbook of African Medicinal Plants,* pp: 124–8. CRC Press Inc. London

Badam, L., R.P. Deolankar, M.M. Kulkarni, B.A. Nagsampgi, U.V. Wagh, 1987. *In vitro* antimalaria activity of neem leaf and seed extract. *Indian J. Malariol.,* 24: 111–7

Devakumar, C. and S. Dev, 1993. *Chemistry Society, Pest Science,* pp: 63–96. Neem Research Developmant Publication, No. 3 India

Devakumar, C., B.K. Goswami and S.K. Mukerijee, 1985. Nematicidal Principles from neem 1*. Indian J. Nematol.,* 15: 121–4

Fujinmi, A.O., S.K. Adedeji, W.A. Hassan and G.M. Babatunde, 1990. Inclusion of neem seeds as feedstuff in rabbit concentrate ration. *Appl. Rabbit Res.,* 13: 125-6

Govindachari, T.R., G. Suresh, G. Gopalakrishnan and S.D. Westley, 2000. Insect antifeedant and growth regulating activities of neem seed oil. *J. Appl. Entomol.,* 124: 287–91

Grant, I.F., A.C. Tirol, T. Aziz and I. Watanabe, 1983b. Regulation of invertebr grazers to enhance biomass and nitrogen fixation of cyanophyceae in Wetland rice field*. J. Soil Sci. Soc. America,* 47: 669–75

Ketkar, C.M., 1983. Crop experiments to increase the efficacy of urea fertilizer nitrogen by neem by-products. *Proc. 2nd Int. Neem Conf. Germany,* pp: 507–18

Khalid, S.A., M. Duddeck, M. Ganzalez-Sierra, 1989. Isolation and characterization of antimalarial agent from neem tree. *J. Natural Prod*., 52: 922–6

Khan, M. and S.W. Wassilew, 1987. The Effect of raw materials from the neem tree. *In*: Schmutterer, H. and K.R.S. Ascher (eds.), *Natural Pesticides from the Neem Tree and other Tropical Plants,* pp: 645–50. GIZ, Eschborn, Germany

Kloos, H. and F.S. Mc Cullough, 1987. Schistosomiasis. Epidemiology, Treatment and Control in East Africa. *Ann. Trop. Med. Parasit.,* 86: 462–71

Krauss, W., S. Baumann, M. Bokel, U. Keller, A. Klenk, M. Klingele, H. Pohnl, M. Schwinger, 1987. *In*: Schmutterer, H. and K.R.S. Ascher (eds.), *Control of Insect Feeding and Development by Constituent Melia azadirach and Azadirachta indica,* pp: 111–25. GIZ, Eschborn, Germany

Lale, N.E.S., 2002. Bio-activity and Limitation against wide spread use of neem products for the management of insect pests. *Nigerian J. Appl. Biol.,* 3: 115–24

Lale, N.E.S. and A. Mustapha, 2000. Efficacy and acceptability of neem (*Azadirachta indica* A. Juss.) Seed oil and Pirimiphos-methyl for the control of *Callosoburchus maculatus* (F.) (Coleoptera: Bruchidae). *J. Pl. Dis. Prot.,* 107: 399–405

Mahmood, R., 1995*. Biological Control of Aonidiella orientalis in Nigeria,* P: 19. FAO, TCP/NIR/4452, FAO Field Document No. 3. Rome

Matig, O.E., 1986. *A Consultative Meeting of the LCBC Member States for Controlling the Cochineal Infesting Neem Tree in Maroua*. 17-19th November, 1986

Mohan, J., P.K. Tyagi, K.T. Pramad, S.V.S. Verma and R.P. Mougal, 1997. Antifertility effect of neem seed kernel meal in chicken. *Ajas,* 10: 609–13

Nagalakshmi, D., V.R.B. Sastry, D.K. Agrawal, R.C. Katigar and S.V.S. Verma, 1996. Performance of Broiler Chicks Fed alkali-treated neem kernel cake. *British Poult. Sci.,* 37: 809–18

National Research Council (NRC), 1992. *Neem: A Tree for Solving Global Problems*. National Academy Press, Washington D.C

Nwokeabia, O.D., 1994. *Annual Report,* p. 46. Federal Department of Forestry, Fed. Min. Agriculture, Abuja, Nigeria

Ogunwolu, E.O. and A.T. Oddunlami, 1996. Suppression of *Callosobruchus maculatus* (F.) on cowpea with *Zanthroxylum zanthoxyloides* (Lam.) Watern. (Rutaceae) compared to neem seed powder and Pirimiphos-methyl. *Crop Prot.,* 15: 603–7

Ohabuike, J.E., 1995. Geographical distribution of neem scale insect in the sub-region. *In*: *Int. Workshop on Neem Scale Insect and Neem Diseases.* 25-27th July, 1995, LCRI, Maiduguri, Borno State, Nigeria

Rao, A.R., S.S.V. Kumar, T.B. Paramassivam, S. Kamalashni, A.R. Parashuraman and B. Shanta, 1989. Viral activities of leaves of Margosa (neem) on vaccinia and variola viruses. A Preliminary report. *India J. Med. Res.,* 57: 495–592

Sadre, N.L., V.Y. Deshpande, K.N. Mendwkar and D.H. Nandal, 1983. Male anti-fertility activity of *Azadirachta indica* in different species. *Proc. 2nd Int. Neem Conf. Ranischolzhausen, Germany,* pp: 473–82

SaiRam, M., S.K. Sharma, G. Havazhagan and W. Selvamurthy, 1997. Immunomodulatory effects of neem oil. *J. Ethnopharm.,* 55: 133–9

SaiRam, M., G. Havazhagan, S.K. Sharma, S.A. Dhamraj, B. Suresh, M.M. Parida, A.M. Jana, D. Kumar and W. Selvamurthy, 2000. Anti-microbial activity of new vaginal contraceptive NIM-76 from neem oil. *J. Ethnopharm.,* 71: 377–82

Schmutterer, H., 1990. Properties and Potential of natural Pesticides from the neem tree, *Azadirachta inidica. Ann. Rev. Entomol.,* 35: 271–97

Schmutterer, H., 1995. *The Neem Tree Source of Unique Natural Products for IPM, Medicine, Industry and Other Purposes*. VCH, Publication New York

Schmutterer, H., 1997. Side effects of neem *Azadirachta indica* Products on Insect Pathogens and natural enemies. *J. Appl. Entomol.,* 121: 121–8

Schmutterer, H. and R.P. Singh, 1995. *In*: Schmutterer, H. (ed.), *List of Insects Susceptible to Neem Products*. VCH, Publication New York

Sinha, K.C., S.S. Riar, A.K. Tiwary, A.K. Dhawan, J. Bardhan and P. Thomas, 1984. Neem oil as a vaginal contraceptive. *Indian J. Med. Res.,* 79: 131–6

Uko, O.J. and T.N. Kamalu, 2001. The neem tree – Uses and Potentials. *Nigerian J. Exptal. Appl. Biol.,* 2: 223–9

Uko, O.J., I.O. Edafiogho and A.M. Ataja, 1995. Possible laxative activity of *Azadirachta indica* (neem). *West African J. Pharmacol. Drug Res.,* 11: 99–106

Verma, S.V.S., S.K. Gowda and A.V. Elangovan, 1998. Responses of single comb white leghorn layers to dietary inclusion of raw or alkali treated neem kernel meal. *Anim. Feed Sci. Tech.,* 76: 169–75

(Received 18 May 2006; Accepted 05 January 2007)