Chapter 18

Phytochemicals as Potential Alternatives to Chemical Insecticides for Controlling Animal Lice

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ABSTRACT

Lice is an ectoparasites that are more prevalent globally. Lice belonging to the order Phthiraptera. Two types of lice are found around the world i.e. chewing and suckling lice. Lice are host specific. The common host for the lice is human, dog, cats, horses, cattles, sheep and goats etc. it is highly infected all over the world due to which synthetic drugs were used to treat this infestation due to the development of resistance by using the same king of drug. It is difficult to control the lice infestation. It is necessary to develop plants-based alternative to cope with this global problem. Plants can control the lice infestation as it contains different type of phytochemicals like saponins, tannins, flavones and fatty acid etc. that can show effective acaricidal effect against the lice. Plants are easily accessible to the poor farmer, cheap and non-toxic source to control the lice infestation. It is concluded that citronella, cloves, ginger, lemongrass, makwan and litsea oil show maximum efficacy against the lice infestation in chicken.

KEYWORDS
Phthiraptera, Insecticides, Acaricidal, Plants, Phytochemical

Received: 03-May-2024
Revised: 06-Jul-2024
Accepted: 12-Aug-2024

A Publication of Unique Scientific Publishers

Cite this Article as: Khalid T, Basit A, Zaman MA, Sarfaraz MZ, Zulqarnain M, Haider F, Haider A, Rahman RAU, Nawaz A and Khalid AR, 2024. Phytochemicals as potential alternatives to chemical insecticides for controlling animal lice. In: Abbas RZ, Khan AMA, Qamar W, Arshad J and Mehnaz S (eds), Complementary and Alternative Medicine: Botanicals/Homeopathy/Herbal Medicine. Unique Scientific Publishers, Faisalabad, Pakistan, pp: 157-162. https://doi.org/10.47278/book.CAM/2024.242

INTRODUCTION

Animal lice, also known as ectoparasites, are tiny insects that live on the skin or in the fur of animals, feeding on their blood, skin, or other tissues. These afflict both people and animals' hair and scalps. There are several types of lice that infest animals, including: Trichodectes (chewing lice), Anoplura (sucking lice), Phthiraptera (biting lice) (Burgess, 2009). Common hosts for animal lice include: humans, Dogs, Cats, Horses, Cattle, Pigs, Sheep and Goats. Signs of lice infestation may include: Excessive scratching or biting, Hair loss or thinning, Skin irritation or redness, tiny eggs (nits) or lice visible on the skin or in the fur and Anemia or weight loss (in severe cases). Lice can transmit diseases and cause discomfort for animals. Treatment options include: Insecticides (shampoos, sprays, or powders), Medicinal shampoos. Flea combs or lice combs, Environmental cleaning and disinfection. Treatments for ectoparasites include lindane, crotamiton, precipitated sulfur, benzyl benzoate, malathion, phoxim, carbaryl, permethrin, ivermectin, imidacloprid, phenol, and phenylpyrazole (Khalil et al., 2017, Mencke et al., 2004, Wright, 1999, Littlewood et al., 1995, Osman et al., 2006, Mencke et al., 2005, da Silva Mendes et al., 2011; French et al., 2016). However, resistance to these treatments often occurs (Martin et al., 2004). Resistance is caused by inappropriate drug prescription, mismatch with the dose prescribed, and no rotation of acaricides used (Chosidow and Scabies, 2006; Thullner et al., 2007). Since the use of acaricides is still the major curative and preventive strategy for ectoparasite infestations (Abbas et al., 2014). There is need to the development of plants-based alternative that are harmless, cheap and easily accessible to the poor farmers.

Prevalence of Lice

The goats within Toba Tek Singh District had a lice infection that ranged from 9.58% to 9.59% (Iqbal et al., 2014). *L. setosus,* a blood sucking louse, and *Trichodectes canis*, a biting louse, are reported from dogs. Dogs can also suffer from louse infestations, leading to symptoms like itching and hair loss (Mehlhorn et al., 2012). *Haematopinus tuberculatus* was reported in Buffalo (Shamim et al., 2015). According to research conducted in Faisalabad in 2006, roughly 18% of the total

buffaloes had lice infestations (Hussain et al., 2006).

In August 2003 Prevalence of lice was 94.45% in pigeon in in India. It started declining in subsequently month i.e., September 2003 to December 2003 reached 58.8% (Ahmad et al., 2009). In the current study, 48% of domestic pigeons were infected with one or more lice species in Iraq (AL-badrani et al., 2023). In Ethiopia, the overall frequency of goat lice infection was 22.9% (Disasa, 2020). According to Azam et al. (2002), there were 34.7% more lice detected on buffalo in Quetta, Pakistan. More to 35.1% of Australian schools have reported having head lice (Speare et al., 2002). After conjunctivitis and diarrhea, head lice infestation is the 3rd most frequently reported outbreak in daycare facilities (Speare et al., 2002).

Life Cycle

There are three phases in the life cycle: nymph, adult, and egg (nit). Throughout her life, the female lays between 50 and 150 eggs, or between four and six nits every day. The oval-shaped eggs have a pale tan tint and resemble tiny sand particles in size. Usually on the top of the head and close to the ears, nits adhere to the bottom of hair shafts close to the scalp. Under typical circumstances, eggs hatch in 5 to 7 days (Figure 1). Nymphs that have just hatched are translucent. They can consume two or three blood meals a day, and they must consume a meal of blood within 24 hours in order to survive. Immature lice go through several nymphal stages in a span of around nine days, during which time they turn straw colored (Mumcuoglu, 2009).

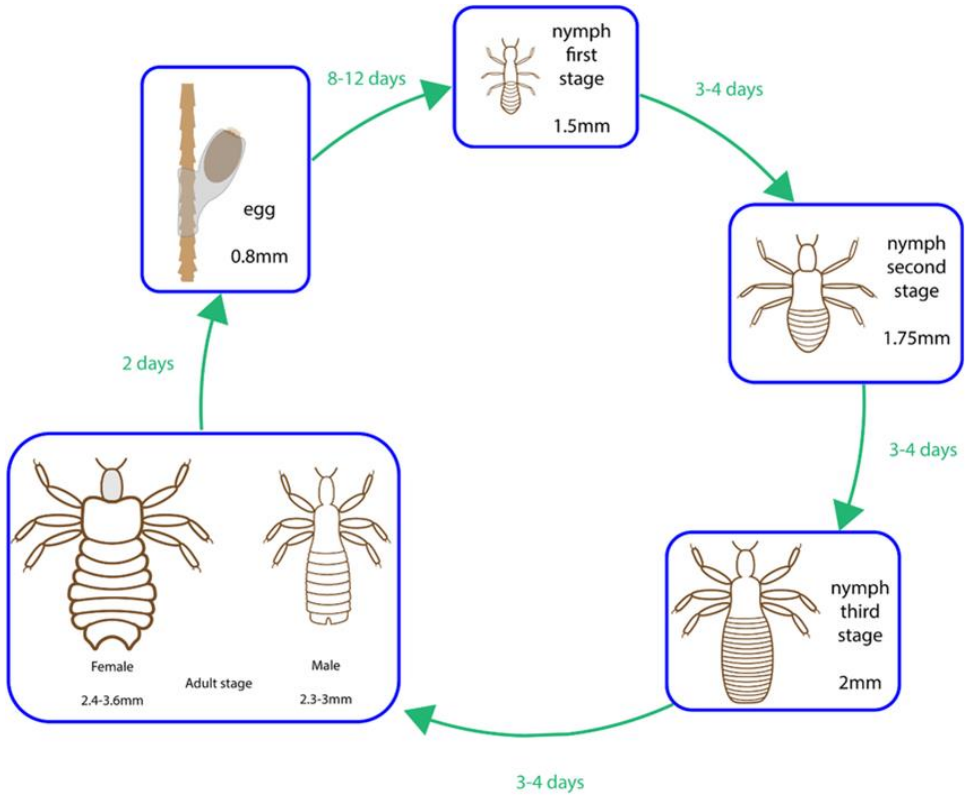

Fig. 1: Life cycle of lice.

Adults can survive a maximum of thirty days after completing their life cycle, which takes 15 to 21 days. It's not always the case that having nits indicates an active infestation. There could be nits from a past infestation. The location of nits along the scalp and hair the shaft can indicate whether an infestation is current or previous since eggs are affixed onto the hairline shaft at the scalp. Human hair grows roughly 1/4 inch and carries the louse egg with it in a week, the length of time that it requires for the egg to hatch. (Guillebeau and Van De Mark 2000). In her adult life, a female louse produces between 50 and 150 eggs. Initial nymphal stage emerges from the egg and, following three molts, develops into nymphs, and ultimately a male or female louse (Mumcuoglu, 2009).

Control of Lice

There is different method of controlling lice infestation in the animals. Lice infestation was control by using chemotherapy. Different drugs were used that shows the maximum output to the infestation i.e. ivermectin, albendazole and permethrin. Like the neurotoxic pediculicides (the drug that is used to kill the lice). Synergized pyrethrin or synthetic pyre thyroid are the active chemicals in the drug that directly affect the lice eventually the lice were kills. These drugs work by inhibiting neuronal sodium transport, leading to respiratory paralysis in larvae and adult lice (Coates et al., 2019). Due to the misuse and over use of the same chemicals to the lice, the lice developed resistance to these chemical drugs. It was difficult

to cope with this condition so it is necessary to develop an alternative that show maximum output with neglected consequences, easily available and are cost effective. Plants based medication is considered as alternative as in ancient time plants were used to treat the disease in the ancient world that was most common in the Asian countries including India, Pakistan and China etc (Meinking et al., 2010; Burgess et al., 2013; Candy et al., 2018).

Use of Phytochemicals

Phytochemicals are natural bioactive substances obtained from plants that are added to animal feed to increase productivity. They are also known as phytobiotics or phytogenics (Gadde et al., 2017). The use of medicinal compound obtained from the plants for the treatment of diseases in known as Phytotherapy (Saeed and Alkheraije, 2023). Phytochemicals can be utilized in solid, dried, and grinding forms, as well as extracts (crude and concentrated). Depending on the method used to obtain the active constituents, they may also be categorized as essential oils, such as coconut oil, tea tree oil, olive oil, garlic oil, petroleum jelly, and mayonnaise (Gadde et al., 2017). Numerous remedies that can be sprayed to human hair and are supposed to prevent the spread of head lice contain natural oils and other substances. These products are sold over the counter by the majority of pharmacies, as well as health stores, beauty salons, and groceries. Garlic has an 8% percentage of ethanol, which makes it excellent for killing head lice. It has been demonstrated to be successful in controlling head lice infestation in 5 hours. Garlic is also frequently utilized for its antibacterial and antifungal qualities. Allicin, saponin, scordinin, and essential oil are found in garlic (Samiasih et al,.2023).

Use of Plants against Lices in vitro and in vivo

Medicinal platns was used against the lices infestation in different animals including humans. Here is the work done by some researcher to evaluate the efficacy of plants against lice infestation including humans is as follow;

The ovicidal activity of a neem seed extract preparation on skull and head lice larvae was assessed by Mehlhorn et al. (2011). The head and body lice species*, Pediculus humanus capitis* and *Pediculus humanus,* were incubated in neem seed extract for five, ten, twenty, 30, or 45 minutes. Neem seed extract has an effective capacity to eradicate head lice eggs and adults. The purpose of this study was to demonstrate that all larvae could be prevented from hatching with a modest 5-minute incubation period. Around 93±4% of the eggs from the untreated human lice measures and around 76% of the head lice controls hatched. This solution offers a complete remedy for lice on the head with just one dose if the head lice (eggs and movable stages) are fully coated for around ten minutes.

Semmler et al. (2012) conducted an evaluation on the importance of testing repellents for lice. It is difficult to restrict lice multiplication by treating affected heads alone because reinfections can happen as soon as a child's head has been completely cleared of lice with an active anti-louse drug. Because of this, many products have been developed with the goal of keeping lice away, however there isn't much hard proof of this.Repelling lice is significantly more challenging than repelling other kinds of insects or even ticks, as demonstrated by the current investigation, which comprised two louse insect repellents (Picksan® NoLice including Linicin® Preventive Spray) including three compounds (at a 10% dilution) acknowledged for their general repellent qualities action. Therefore, it is vital to be worried that some repellents available the market could not be as efficient as they claim since they might have been produced using an inaccurate testing method.

Comparative efficacy of new commercial pediculicides against adults and eggs of *Pediculus humanus capitis* (head lice) was studied by Gallardo, Anabella, et al. (2012). In controlling head louse infestations, the effectiveness of pyrethroids has significantly decreased due to resistance to these drugs. Since head lice treatments can be bought in Argentina, many of them have been produced in recent years. The purpose of this study was to compare the efficacy of both newly invented Argentinian items, Nopucid Qubit® or Nopucid Bio Citrus®, to two standard products, Nyda® and Hedrin®. Nopucid Qubit®, a two-phase lotion, contains ciclopentaxiloxane in phase two and geraniol and citronellol in phase one. Nopucid Bio Citrus®, conversely, ciclopentaxiloxane and dimethicone have been added. Furthermore, two laboratory experiments were employed to evaluate the sensitivity of the new formulations' insecticidal effectiveness. Both in the laboratory and in vivo, motile forms died before receiving exposure to a particular chemical for only a few minutes. Our research proved that official over-the-counter pediculicides have been successful against head lice eggs or motile stages for the first time in Argentina.

The Toxicity of Essential Oils from Three Origanum Species against *Pediculus humanus capitis*, the head louse, has been evaluated by Arserim et al. (2021). *Capitis humanus pediculus* Children of school age who have De Geer are at risk for the disease. Although a variety of chemical pediculicides have been used to eradicate lice, resistance has grown over the past few decades. As an alternate source of lice treatment chemicals, essential oils from plants have been employed. In this work, the pedalicidal activity of three Origanum species' essential oils against adult *P. humanus capitis* was investigated. Three Origanum species' aerial portions were hydrodistilled using a Clevenger-style device to extract the essential oils. The *P. humanus capitis* organisms that were utilized came from children who had been infected by combing at elementary schools. Applying the adult immersion test, human lice were subjected to three dilutions (1%, 0.5%, and 0.1 percent w/v) of tested oils for five minutes. The findings indicate that at 1% concentration, all Origanum oil constituents have been demonstrated to significantly reduce the rate of bowel, abdomen, and limb movements, resulting in more than 90 percent mortality within 12 hours. Our findings suggested that novel pediculicides towards head louse could be developed using essential oils from Origanum.

Al-Timimi et al. (2022) Assessing the effectiveness of Capparis spinosa Total flavonoids in the management of Menacanthusstramineus avian lice. This study included both in vitro and in vivo flavonid research on Capparis spinosa on chicken lice that were grown locally. All 115g of newly collected plant samples' flavonoids were extracted by reflex extraction. The necessary aglycon component was created by working nonstop for eight hours, and 600 milligrams of distilled water were mixed using 10% v/v HCl with ethyl acetate as the solvent for this purpose. The remaining material was weighed when the acetate layer dried and was examined qualitatively and quantitatively. In one hundred milliliters of distilled water, triple polyphenols (Capparis spinosa complete flavonoids) were compared to a positive control that included 0.5 mg/mL of permethrin. The use of distilled water is applied as a countermeasure. The study's findings demonstrated that the herb is rich in various flavonoids and has the ability to eradicate chicken lice from the skin at various phases of their life cycles. The impact on killing lice eggs and nymphs was larger when the percentage of the extract was increased; however, this difference was not statistically relevant in terms of killing adult lice.

The impact of COVID-19 and the delayed retrieval of lice prevalence in Cambridgeshire, UK, were assessed by Burgess et al. (2023). After adult and child interaction habits changed and schools were closed, there was a confirmed global decline in the prevalence of head lice. Concurrently, a decrease in therapeutic sales was seen, possibly as a result of product supply problems following the pandemic, but this did not appear to contribute to a rise in infestation cases. Examining schools close to Cambridge, UK, showed a significant drop in infection rates compared to surveys conducted prior to the COVID-19 pandemic, particularly in urban schools. In contrast to forecasts, the number of cases has gradually increased since schools started full-time operations in 2022–2023.

The prevalence of kid alterations resistance to insecticide in head lice *(Pediculus humanus capitis*) among elementary school pupils in Jeddah, Saudi Arabia, was assessed by Alsaady et al. in 2023.A growing body of evidence indicates that scalp lice (*Pediculus humanus capitis*), a serious global health concern, are becoming more common among Saudi children. The purpose of this study is to determine how frequently a mutation causing insecticidal resistance occurs in head lice collected from students. To find the location and frequency of the kdr T917I mutations in head lice, a polymerase chain reaction, or PCR, was used to ramp up the voltage-gated potassium channel gene component. Subsequently, two genotypic types were found using restriction fragment length polymorphism, or RFLP, patterns: homozygous-susceptible (SS) versus homozygous-resistant (RR) (Larkin et al., 2020).Of the forty-five samples, seventeen (37.80%) proved to be SS and twenty-eight (62.2%) to be RR. The RR sample's amino acid and nucleotide sequences were found to incorporate point mutations like T917I and L920F. Compared to other countries, Saudi Arabia's scalp louse population had a low prevalence of minoxidil resistance mutation. This study provides the first evidence of a permethrin sensitivity mutation in human lice living in Saudi Arabia. The findings of this investigation will show how the kdr mutation is increasingly affecting lice on the head in Saudi Arabia.

A study conducted in 2021 by Vigad, N., et al. examined the physical properties, chemical compositions, and insecticidal effectiveness of plant essential oils against parasites as well as chicken lice (Menopongallinae). It was decided to create an essential oil preparation to combat mites (Ornithonyssus bursa) and chicken lice (Menopongallinae). All the essential oils shown efficacy against lice and mites in vitro. Chicken lice died at a rate of 100% when citronella oil was used at the lowest dose of 0.208 µg/cm2, while cloves, ginger, lemongrass, Makwan oil (0.416 µg/cm2), and litsea oil (0.832 µg/cm2) were also shown to be effective at greater concentrations

Conclusion

Lice infestations are a common condition affecting millions of animals i.e. dog, sheep, buffalos, cow, and goats as well as humans each year. This Infestations can cause damage to physical and mental health and are difficult to control because of developing resistance to the currently used synthetic drugs in the developing countries. It is required to formulate the plant-based alternative to treat this infestation. It is cheap, less expensive and easily available to the farmers. However, Extensive research is required to solve the problem of resistance by using different plants and describe their phytochemicals that was more effective to the lice.

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