



# Lousicidal and repellency properties of two plant extracts against human head louse, *Pediculus humanus capitis* Charles De Geer. (Phthiraptera: Anoplura)

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Received: 14.07.2017; Revised: 21.08.2017; Accepted: 15.10.2017

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**Abstract:** Leaf extracts of Himalayan shrubs Timru (*Zanthoxylum alatum*) and Raimunia or Lantana (*Lantana camara*) and flower extracts of *L. camara* have been tested for their lousicidal and repellency properties against human head louse, *Pediculus humanus capitis* (Phthiraptera: Anoplura). The crude extract of these plants were noted very effective in other insects. The mortality rate and repellency were noted 80% and 86.36% in case of *Z. alatum* while 66.67% and 76.19%, respectively in *L. camara*. Flower extract of *L. camara* caused 56.67% mortality and 66.18 % repellency. Preliminary results of these plants extracts clearly exhibited lousicidal effects.

**Keywords:** Human head louse • Lousicidal • plant extracts • repellency

## Introduction

Head louse infestation is a global problem and varies greatly from place to place. Children are the most affected group (Gratz, 1997). Considerable work has already been done on prevalence rate of head louse in different parts of the world. Many other workers get success to eradicate head louse through different synthetic pesticides (Maunder, 1971; Pollack et al., 1999; Yoon et al., 2003; Kerryn and Tanya, 2012; Dadas et al., 2016). These pesticides increases pest resistance, harms non-target beneficial organism, contaminate feed, create environment hazard apart from economic consideration. Moreover, by using these synthetic pesticides many other birds and mammals are

affected with immune suppression, environmental pollution and development of resistant of strain. Several authors have already mentioned that intensive and continuous application of biodegradable pesticides may be an asset from environmental as well as economic point of view. Biodegradable pesticides are not only safer but eco-friendly also. Several plant extracts have also been efficiently tested against pest of dogs, buffaloes, cattle and birds (Tripathy et al., 1995, Banerjee, 1997; Kumar et al., 2002a, b and 2011; Lakshmanan et al., 2016). Furthermore pesticidal properties of several other plants have been tested against different pests (Murray et al., 1995; Maske et al.,

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1999; Khater et al., 2014). Lousicidal and repellency properties of some selected plant (viz. *Azadirachta indica*, *Adhatoda vassica*, *Argimone mexicana*, *Acorus calamus*, *Cassio fistula*) have already been tested by Kumar et al. (2002a, b and 2003); Khan et al. (2008); Kosalge and Fursule (2009); Nalamwar et al. (2009) against tropical hen louse. Some other workers like Heukelbach et al. (2006a and b); Semmler et al. (2010); Shrivastava et al. (2010); Toloza et al. (2010a and b); Bagavan et al. (2011) and Combescot et al. (2015) tested *A. indica*, *Eucalyptus*, *Citurs*, *Syzygium* and *Vitex agnus castus*, respectively, against human head louse to note mortality and repellency. Isman (2000); Abdel-Ghaffar and Semmler (2007); Shaaya and Rafaeli (2007); Rossini et al. (2008); Purval et al. (2010); Toloza et al. (2010); Rassimi and Soonwera (2011); Watcharawit and Soonwera (2013); Soonwera (2014) also reported some plants essential oils and plants extract against human head louse as eco-friendly, biodegradable, possess low or no toxicity against mammal and very effective against insect pests. *Eucalyptus* has also been tested against insects (Papachristos and Stamopoulos, 2002; Lucia et al., 2007 and Batish et al., 2008) and head lice (Yang et al., 2004; Toloza et al., 2006, 2010a and b; Choi et al., 2010). Plant extract of monk pepper exhibits repellency activity against head lice, ticks and insects (Semmler et al., 2010) but Mehlhorn et al. (2005) suggests monk pepper extract as repellency activity against lice only for short period.

The aim of the present study was to investigate and evaluate the lousicidal and repellency properties of different parts (e.g., leaf, flower, etc.) of *Zanthoxylum alatum* and *Lantana camara* against human head louse. Least work has been done on lousicidal and repellency properties of some plant extracts in Uttarakhand region, so keeping in view the lacunae in the fields, the present study was carried out.

### Materials and Methods

Leaves (*Z. altum* and *L. camara*) and flower (*L. camara*) collected from Kotdwar (Garhwal) and its adjoining area, were thoroughly washed, dried (under shade) and powdered in a domestic hand

grinder. Extracts of these plants material were prepared by using acetone and kept in 12 hrs, at room temperature (28+2°C). Later on, extracts were filtered through Whatman filter paper (No.1) and solution left on Petridish, kept for one to two days for evaporation. The residue of the extracts stored in deep freezer. The extracts were then tested for mortality and repellency on lice at various concentrations (Kumar et al., 2002a, b and 2003; Khan et al., 2008). For conducting the mortality test, saturating concentration of stock solution was placed on filter paper (Whatman filter paper No. 1, diameter 9.0cm) and allows dry in shade, at room temperature (28+2°C) in Petridishes. Healthy adult lice (*P. humanus capitis*) of both sexes in nearly equal proportion sorted out from infested children and adult in randomly selected locality of Kotdwar and its adjoining areas. Live head lice were collected by using a fine-toothed anti louse comb (Picollo et al., 1998 and 2000; Vassena et al., 2003) and kept in an environmental chamber and with the help of camel hair brush were transferred on the treated filter paper in Petridishes. Male and female head lice can be easily distinguishable due to their size, but attempt have not been made to record sex wise mortality. Mortality test were performed in three sets along with control unit (using acetone). Ten-ten active fresh healthy adult lice of both the sexes were released on each of the three replicate the lice were then reared *in vitro* environmental chamber at 29±2°C and 60-80% R.H. *In vitro* bionomics of human head louse has already been done (Takano-Lee et al., 2003). Mortality was recorded after every 2 hrs interval and the percentage mortality was calculated for each of sets up to 24 hrs then average percentage mortality was noted by using the formula.

$$\text{Mortality} = \text{ND/NT} \times 100 \dots \dots \dots \text{Equation No. 01}$$

Where, ND= Number of dead lice, NT= Number of total lice

For checking the repellency of said plants extracts against human head louse, one half portion of Whatman filter paper was immersed in test solvent and then allowed to dry. The other half was dipped in pure solvent (acetone) and dried. Such a

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filter paper was placed in Petridish, which were covered with glass funnel of same diameter was inverted over the Petridish and its joints were sealed (to avoid the escape of lice). Repellency tests were also performed in triplicate sets. In each Petridish ten healthy adult (both sexes) lice were released on the test area. Then Petridish were placed inside the environmental chamber maintain at  $29\pm 2^{\circ}\text{C}$  and 60-80% R.H. The numbers of lice on treated and untreated side were recorded after every one hr interval. The repellency was calculated for each Petridish up to 12 hrs and average percentage repellency was noted by using the formula suggested by Kumar et al. (2002a and b).

Repellency% =  $\frac{UT \times 100}{UT + T}$ ...Equation No. 02

Where UT= Number of lice trapped in untreated side, T= Number of lice trapped in treated side

An attempt was also made to examined the lice on the filter paper under a dissecting microscope by a single observer in all cases to prevent inter observer variation. The criteria used for survival of lice were extremely strict, if any even minor signs of life, such as internal movements or movement of antennae or minimal leg movements were observed (with or without stimulation by a forceps), the lice were categorized as alive. The lice were judged as dead if there were no vital signs at all (complete physical death). These data were compared to the usual criteria "mortality", the inability to walk in a progressive fashion or no righting reflex when rolled onto the back (Mougabure et al., 2002 and Hunter and Barker, 2003).

## Results

The result on mortality against *P. humanus capitis* at 2 hrs, 4 hrs, 6 hrs, 8 hrs, 10 hrs, 12 hrs and 24 hrs duration, caused by leaf extract of *Z. alatum*, *L. camara*, and flower extract of *L. camara*, was presented in Table – 1. Leaf extract of *Z. alatum* exhibited 0%, 16.67%, 30%, 40%, 46.67%, 53.33% and 80%, respectively. In case leaf extract of *L. camara* the same were noted as 3.33%, 10%, 10%, 16.67%, 23.33%, 36.67% and 66.67%, respectively

(Table 1). Similarly flower extract of the *L. camara* exhibited mortality 0%, 3.33%, 10%, 16.67%, 20%, 26.67% and 56.67%, respectively. In control unit, there was no any mortality up to 6 hrs, but it was noted 3.33% in 8 hrs, 6.67% in 10 hrs and 12 hrs duration, while in 24 hrs it reached 10% mortality. Overall mortality of leaf extract of *Z. alatum* and *L. camara* exhibited 80% and 66.67%, while flower extracts of *L. camara* showed 56.67% overall mortality (Table 1). There was only 30% overall mortality recorded in control unit. Present results clearly indicated that these plants extracts possesses effective mortality against human head louse, *P. humanus capitis*.

Attempts were made to note the repellency efficacy leaf extract of *Z. alatum* against said lice. Repellency after 1 hrs, 2 hrs, 3 hrs and 4 hrs have been noted as 80%, but in 5 hrs duration it increases up to 100%, while notable fall was noted in 6 hrs duration (up to 88.89%)(Table 2). After 12 hrs duration it again reaches up to 100% repellency. Overall repellency of leaf extract of *Z. alatum* noted as 86.36%. Similarly repellency efficacy of leaf extract of *L. camara* were remained 50%, 60%, 80%, 77.78%, 88.89% and 87.5% at the duration of 1 hr, 2 hrs, 3 hrs, 4 hrs, 5 hrs and 6 hrs respectively, while it was found 100% repellency at the 12 hrs duration. Overall repellency were remained slightly lower (76.19%) in comparison to leaf extract of *Z. alatum* (86.36%) (Table 2). Repellency of flower extract of *L. camara* were noted as 40%, 50%, 70%, 70%, 80%, 80% and 75% at the duration of 1 hr, 2 hrs, 3 hrs, 4 hrs, 5 hrs, 6 hrs and 12 hrs, respectively. Overall, 66.18% repellency of flower extract of *L. camara* against *P. humanus capitis* was noted.

Mortality (80%) as well as repellency (86.36%) was found higher in the leaf extract of *Z. alatum*, followed by leaf extract of *L. camara* (mortality 66.67% and repellency 76.19%) and flower extract of *L. camara* (mortality 56.67% and repellency 66.18%) respectively.

**Table 1** Showing mortality of head louse (*Pediculus humanus capitis*) treated with leaf extracts of *Zanthoxylum alatum* and *Lantana camara* and flower extract of *Lantana camara* along with control group at two hours interval.

Extracts	No of lice	Set of test	2 hrs	4 hrs	6 hrs	8 hrs	10 hrs	12 hrs	24 hrs	Total	Percentage
<i>Zanthoxylum alatum</i> (leafs)	10	I	0	2	1	1	1	1	2	8	80
	10	II	0	1	2	0	1	1	3	8	
	10	III	0	2	1	2	0	0	3	8	
<i>Lantana camara</i> (leafs)	10	I	0	1	0	1	1	2	2	7	66.67
	10	II	1	0	0	1	0	1	3	6	
	10	III	0	1	0	0	1	1	4	7	
<i>Lantana camara</i> (flowers)	10	I	0	0	1	0	1	1	3	6	56.67
	10	II	0	0	1	1	0	0	3	5	
	10	III	0	1	0	1	0	1	3	6	
Control unit	10		0	0	0	1	1	0	1	3	30

**Table 2** Showing repellency efficacy of leaf extracts of *Zanthoxylum alatum* and *Lantana camara* and flower extract of *Lantana camara* against human head louse, *Pediculus humanus capitis*.

Extracts	No of lice	1 hr		2 hrs		3 hrs		4 hrs		5 hrs		6 hrs		12 hrs		Total		%age
		T	UT	T	UT	T	UT	T	UT	T	UT	T	UT	T	UT	T	UT	
<i>Zanthoxylum alatum</i> (leafs)	10	2	8	2	8	2	8	2	8	0	9	1	8	0	8	9	57	86
<i>Lantana camara</i> (leafs)	10	5	5	4	6	2	8	2	7	1	8	1	7	0	7	15	48	76
<i>Lantana camara</i> (flowers)	10	6	4	5	5	3	7	3	7	2	8	2	8	2	6	23	45	66

## Discussion

Complete physical death of louse is very essential to observe the mortality, as it is known that head lice can resurrect within a short period of time (Burkhart and Burkhart, 2006). The same can be check by using usual and strict criteria for mortality. Present report indicated that leaf extracts of *Z. alatum* (80% mortality) and *L. camara* (66.67% mortality) are very effective against *P. humanus capitis* (human head louse), while flower extract of *L. camara* exhibited moderate effects (56.67%). Many plants extracts now used as substitute of synthetic pesticides in form of oil herbal product or shampoo (e.g., *Azadirachta*, *Cinnamon*, *Adhatoda*, *Eucalyptus*, *Marjoram*, *Pennyroyal*, *Lippa multflora* and *Rosemary*, etc.). These oil herbal product or

shampoo, have already proven effective against lice of animals and humans under *in vitro* condition (Maske *et al.*, 1999; Yang *et al.*, 2004; Heukelbach *et al.*, 2006a and b; Abdel-Ghaffar and Semmler, 2007; Batish *et al.*, 2008; Khan *et al.*, 2008; Purval *et al.*, 2010; Rassimi and Soonwera, 2011; Watcharawit and Soonwera, 2013; Soonwera, 2014; Combescot *et al.*, 2015).

A number of effective synthetic insecticides/pesticides are in the market by which insects/pests are controlled, but their extensive and indiscriminate use has lead to environmental hazards including persistence of residues, development of pest resistance and targeting of non-target beneficial pest. There are many plants including Uttarakhand having insecticidal/pesticidal

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properties which not only eradicate the insect/pests but also act as natural toxic repellent (Alam et al., 1990; Dubey et al., 1990; Ahmad et al., 1993; Rao and Singh, 1994; Venkatachalam et al., 1996). Lousicidal properties of leaf extract of *Z. alatum* against poultry wings louse, *Lipeurus caponis* have already been tested by Kumar et al., 2002a and b. Over 93.4% repellency properties of leaf extract of *Z. alatum* has been noted against *L. caponis*. Present results indicated almost similar results (86.36%) on repellency against human head louse.

Various plant species (having insecticidal, antimicrobial and antifungal properties) are available in Himalayan region of Uttarakhand. Being easily available, herbal shampoo or oil based product of *Z. alatum* and *L. camara* not only become cost effective, non-toxic and eco-friendly but also dominant the synthetic pesticides if properly used.

#### Acknowledgements

Authors are thankful to Principal, Dr. Pitambar Dutt Barthwal Himalayan, Government Post Graduate College, Kotdwar (Garhwal) for providing laboratory facilities; to Dr. A.K. Saxena (Associate Professor, Dept. of Zoology; Govt. Raza P.G. College, Rampur, U.P.) for louse identification and to Dr. G.S. Rajwar (Principal, Govt. Degree College, Narendra Nagar, Tehri Garhwal for plant species identification.

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