Possibility of harnessing the ectoparasiticidal potential of an ayurvedic liniment in young goats

Attaching to the body of livestock, the ectoparasites, ticks (phylum: Arthropoda, Arachinda), lice and fleas (phylum: Arthropoda, Insecta) cause constant irritation, restlessness and anaemia as well as transmit infectious diseases resulting in substantial economic loss to the farmers. Many chemical therapeutic agents have been employed to control these infestations. They are normally safe, but some of them may be responsible for toxic reactions in animals, reduced efficacy in the long run due to development of resistant strains of ectoparasites, environmental pollution and human health hazards. To avoid such adverse effects, plant-derived products against ectoparasites are preferred now as better alternatives. The common plants used in tick control have been listed[1] and reviewed[2]. The efficacy of herbal extracts *in vitro* against poultry lice has also been reported[3]. Herbal compounds, AV/EPP/14, Ectozee and Pestoban-D are known to be efficient to control ectoparasites of animals.

As a part of the search for novel plant-derived ectoparasiticides, we came across Arlin, an ayurvedic proprietary liniment for joint pain (Retort Pharmaceuticals Pvt Ltd, Chennai, India). This product was chosen as its ingredients consist of eucalyptus oil, turpentine, deodar oil and camphor which are known for anti-parasitic properties, mixed with other herbal oils. A trial was conducted to study the extent of probable anti-ectoparasitic action of Arlin against the natural infestation of ticks, lice and fleas on young goats (kids) and the results are reported here.

The trial was conducted at the Zonal Research Station, Konehally, Tiptur, Karnataka. Six goat kids (5–6 month old) carrying concurrent infestations of three ectoparasites, ticks, lice and fleas were used for conducting the trial and the infested kids were separated from the flocks. The extent of ectoparasitic load of ticks on the body of the kids was assessed by taking the sample count of those attached to the pinna of the ears, whereas those of lice and fleas by counting their number at 5 cm^2 area at the inguinal region. Later, 0.4% aqueous emulsion of Arlin was sprayed uniformly over their entire body as a single application. The treated kids were allowed to graze together with the rest of the flock as usual. The post-treatment ectoparasitic counts were done in a similar manner at weekly intervals. The percentage of efficacy was calculated based on the initial count using the formula: $T1 - T2/T1 \times 100$, where $T1$ the pre-treatment count and $T2$ the post-treatment count of ectoparasites.

The ectoparasites found on the kids were species of *Hyalomma* and *Haemaphysalis* (ticks), *Linognathus* (louse) and *Ctenocephalides felis orientis* (flea). The result of a single application of 0.4% Arlin spray on the kids showed a reduction of 28.89% and 26.67% of ticks and 20.48% and 27.71% of lice on days 7 and 14 respectively. But fleas showed uniform reduction of 41.67% for the first two weeks. However, a maximum reduction of 42.22%, 44.58% and 75% of ticks, lice and flea infestation respectively, was achieved on day 21. The effect of even the slightest residual effect of pesticide might have enabled to reduce the flea population to the extent of 75%, which is noteworthy; but the effect was not remarkable with respect to ticks and lice as revealed by the results.

Studies showed a higher percentage of efficiency of Arlin with fleas compared with those of ticks and lice. The reason for higher reduction of flea population on the kids might be attributable to a certain extent to the special ability of fleas for escaping from the body of the hosts by their leaping movement, probably to avoid the pungent smell, the irritant or toxic effect of the emulsion. Unlike fleas, the attachment of lice and ticks to their hosts is comparatively firmer and their movement is sluggish. In the present trial with Arlin as well as our previous trials with azadirachtin fraction of neem seeds, higher elimination of fleas than lice was experienced, indicating that the fleas were more vulnerable to botanical insecticides[4].

This preliminary *in vivo* trial was conducted to see whether 0.4% Arlin could produce any reduction of common ectoparasites of kids and any untoward effect in the sprayed animals. The overall results revealed that even a low concentration of 0.4% Arlin was fairly effective in flea control, though it could marginally reduce the infestation of lice and ticks. However, in another recent trial, instead of spraying, 0.5% Arlin was applied by cotton swabs on ticks attached to the ears of adult sheep and goats and a higher reduction of 65.15% and 75.54% respectively was noticed on day 21 (ref. 5). It is expected that the efficacy of Arlin can be further enhanced by either increasing the number of applications or its concentration.

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Biology education in India

The editorial on 'Teaching research: addressing a new generation'[1] is timely and focuses on an important issue. Before teaching a researcher in biology how to embark upon the problem with necessary knowledge of the literature, tools, equipment, etc., the most important thing is to know whether he/she has a sound background of the subject itself. Strengthening the biology education system will greatly improve the present scenario. In my opinion, the editorial is full of knowledge and information to both young and old. The statement that 'jobs in academia are significantly more attractive than in the past', is absolutely correct. However, the other side of the picture is that in many states like Madhya Pradesh, Uttar Pradesh, Rajasthan and Bihar, the state of higher education is pathetic. There is no or negligible recruitment in state universities and colleges for the past many decades. There is no replacement of retired teachers in the teaching departments. In some cases, ad hoc, part-time teachers with meagre salary are being enrolled. About four decades ago the state university services were better than those in the colleges. Now the university teachers have been deprived of many benefits, including retirement perks, etc.

Balaram's statement, 'The excitement of science and pleasure of research can only be communicated by exposing students at the earliest,' is a fact which cannot be explained in words. Unfortunately what happened in India during the last many years is just the reverse. I shall enumerate a few causes. The experimental work in biology, i.e. in botany and zoology teaching classes has almost completely abandoned right from middle school to upper college level. At the undergraduate level, only a few experiments are being performed at the time of examination. In the postgraduate classes too, experiments are being performed mostly in practical record books only. One of the excuses for not providing the animal material for experimental purposes by school and college authorities is that the Government has banned the use of some living animal material for experimental and research work. This problem can be overcome by exploring alternative experimental animal models in which basic anatomical, morphological and physiological processes can be well demonstrated. Another reason is that the teachers have no knowledge of acquiring, preserving or keeping living biological material in their institutions. The situation is not different in undergraduate medical education. Another reason for the decline of zoology/botany education in India is the starting of biotechnology and microbiology courses at the undergraduate level. This has caused more harm than benefit to biology education, as the student has to opt only botany or zoology along with biotechnology or microbiology. Thus we need to develop an 'inquiry-based instruction' system, for which teachers at schools and colleges need sufficient training, knowledge, expertise, zeal, enthusiasm and dedication to the cause of science.

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Why waste citrus peel?

Juices extracted from citrus fruits are used in processing industries, but the peel and other waste materials are often thrown away. This not only creates environmental hazard, but also incurs cost of its disposal. Interestingly, if citrus wastes are used properly, they could serve in establishing other related industries.

Citrus peel yields citrus oil which serves a number of useful purposes. Several good methods are available for the extraction of citrus oil[1]. Grape fruit or orange peel yields naringin, also known as flavonone glycoside. Various food industries use this product in the preparation of bitter 'tonic' beverages, bitter chocolate, ice creams, etc.

Naringin works as a powerful antioxidant protecting the body from free radicals, thereby reducing the risk of cancer. It is also used in the treatment of gastric lesions and in the nutrition industry to increase uptake of supplements such as caffeine. In treating diabetics, it works as an aldose reductase inhibitor which inhibits the enzymes that turn glucose into other sugars, thus helping to fight retinal disease linked to diabetes. By enhancing lipid metabolism, it reduces the risk of atherosclerosis and other fat-related disorders. It can be used to obtain naringin dihydrochalone, a compound which is 300–1800 times sweeter than sugar.

Besides, citrus ethanol produced from citrus wastes is used as a fuel. Most ethanol is produced from corn which is cost effective. The food value of these crops is much higher than the fuel value. Evidently, alternate sources of production of ethanol like citrus wastes need exploration[1].

Citrus oil and the extract obtained from citrus-fruit peel are antifungal and antibacterial in nature. It has been found effective against Gram-positive strains such as *Staphylococcus aureus*, *Bacillus subtilis* and Gram-negative strains such as *Escherichia coli*, *Klebsiella pneumoniae* and *Salmonella typhi.* Citrus peel is fungitoxic to *Aspergillus flavus* and *A. niger*.

Oil of citronella or the constituent, citronellal, is also used in mosquito coils. Several veterinary products for flea and tick control in domestic pets contain *d*-limonene (from citrus peels) as the active ingredient. Other uses include perimeter treatments of buildings against termites and the use of essential oils to repel cockroaches and flies[2]. Contact with orange oil kills termites by damaging their exoskeleton, causing loss of water and protein[3]. Another important use of plant essential oil constituents is in the fumigation of beehives to manage economically important honey-bee parasites, the varroa mite (*Varroa jacobsoni*) and the tracheal mite (*Acarapis woodi*)[4–7].

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