

# Bio-efficacy of Tabard Spray and Tabard Lotion against Malaria Vectors in Laboratory and in the Field Conditions

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## Abstract

Personal protection tools are of paramount importance for the control of residual malaria transmission in both urban and rural settings. The current study evaluated the repellent efficacy of Tabard lotion and Tabard spray against a standard DEET (N, N-diethyl-3-methylbenzamide). Bioassays were conducted to evaluate the efficacy of Tabard lotion, Tabard spray and DEET against *Anopheles gambiae* s.s. in the laboratory and in field situations. Field evaluations were carried out from 1800 h to 0300 h. Protection efficiency of above 90% was achieved for Tabard (both spray and lotion) and DEET while the feeding inhibition was not found to be statistically different, but decreased for both after 8 hours of application from 100% to 60.98% in spray and 98.81% to 91.99% in lotion. Probing inhibition of the two repellents decreased with time. No any adverse side effect was reported from the field and laboratory participants who applied the evaluated products in their skin. The findings of this study have proved to be protective for 8 from anopheles mosquitoes bites.

**Keywords:** *Anopheles gambiae* s.l.; Tabard lotion; DEET; Tabard spray; Vectors

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## Introduction

Reduction of Human vector contact is of most important in reducing malaria transmission. In recent past, WHO report have indicated that malaria death and morbidity related cases have been reduced significantly globally [1]. The major tools for malaria vector control which have lead to the observed decline of malaria related death cases and morbidity are IRS and LLIN coverage programmes [1]. Due to this achievement, malaria transmission has decreased tremendously to residual malaria transmission [2-4]. More efficient tools such as personal protection tools are needed to add value on the achieved efforts. Since its inception in market as a repellent, DEET has performed well with a protection of up to 8 hours since topically applied [5-10]. Having more brands of repellents in market gives user opportunity to avoid those with allergic reactions with.

Protection from *arthropod* bit is best achieved by avoiding infested habitans, wearing protective clothing and using Insect repellants [5,6]. In many ways direct application of repellent on skin might increase protection against biting Insects. Given that, a single infectious bite can result into disease transmission its

very useful to know which repellent product can be relied on to provide prolonged prevention from vector bites. The best known chemical insect repellent is N, N-diethyl-m-toluamide, now called N, N-diethyl-3-methylbenzamide (DEET) [5,6,10].

This trial evaluated Tabard lotion and Tabard spray with DEET (15%) as active ingredient compared to gold standard DEET lotion (20%) in laboratory and field situation against *Anopheles gambiae* s.l.

## Methods

Tabard lotion (TL) and Tabard sprays (TS) are mosquito repellents, with 15% N-N Diethyl Benzamide, these products were evaluated for their efficacy against anthropophilic mosquitoes. DEET (97% N-N methyl toluamide), was tested alongside TS and TL as a gold standard for comparison purposes. The study was carried out

from November, 2016 to January, 2017 in the laboratories while field trials were conducted at Lower Moshi irrigates rice fields, 10 km South of Moshi town.

### In laboratory screening

The tests were conducted at Tropical Pesticide Research institute (TPRI) located at Ngaramtoni-Arusha, Tanzania in a laboratory maintained at  $27 \pm 2^\circ\text{C}$  and 78-80% relative humidity. Laboratory reared 3-5 day old female unfed mosquitoes were used for bioassays. Testing was done in the laboratory maintained at standard temperature and humidity against laboratory strains of *Anopheles gambiae* s.s. in cage bioassays using authors as human volunteers (Eliningaya Kweka, Violet Temba and Lucile Lyaruu). The following repellent were tested: TL and TS contained 15% N-N Diethyl benzamide. The repellent was applied on an approximate 98 cm<sup>2</sup> area of one of the fore arm of the volunteers while wearing gloves to cover the fore arm.

Evaluation of probing inhibition for *A. gambiae* using TS, TL and DEET lotion was carried out in two cages each containing a total of 50 unfed females of *A. gambiae* s.s.. The mosquitoes were introduced in cages with 30 x 30 x 30 cm dimension. The arm of a person treated with TL or TS was introduced in the cages and the number of mosquitoes landing on arms were counted on evaluated repellents while using DEET (lotion or spray) as positive control. Each experiment had three replicates and repeated 3 times.

At the same time, evaluation of feeding inhibition for *A. gambiae* was carried out using TS, TL and DEET (lotion and spray). Two cages each containing a total of 50 unfed females were exposed for 30 minutes on arms treated with liquid paraffin (negative control), arm treated with TL or TS containing DEET 15% and with DEET (lotion and spray) containing DEET 20%. The proportions of fed mosquitoes were recorded for each category of treatment. Also experiment had three replicates and repeated 3 times.

### Field trials

In the field six teams each with two individuals of 18 years and above were selected for conducting of human landing catches for the trials. Six sites were selected and each team applied TL, TS, DEET and control group applied liquid paraffin. Each group applied at 17:30hrs and sampling started at 1800hrs to 0300hrs. The design was 4 by 4 Latin square experiments. Mosquitoes collected hourly were preserved in the cups and transported to laboratory for identification.

Probing inhibition was calculated using the formula for probing inhibition percentage

$$=(C_p - T_p / C_p + T_p) \times 100\%$$

From the equation,  $C_p$  is the number of mosquitoes probed in control arm,  $T_p$  is the number of mosquitoes probed in treatment arm.

After calculating the probing inhibition percentages, they were compared by paired samples t-test between evaluated product TL, TS and DEET. The same was done for feeding inhibition using WHO guideline for testing repellents [11].

The field data were analyzed with General linear model univariate

analysis with mosquitoes as independent variable, treatment fixed factor and days as random factor.

## Results

In the laboratory comparison of probing percentage inhibition between Tabard lotion, Tabard spray and DEET lotion was found that, probing inhibition percentage for TL, TS and DEET lotion had no statistical difference on 0 hour ( $P=0.216$ ), after 4 hours ( $P=0.116$ ) and after 8 hours ( $P=0.122$ ) (**Figure 1**). Probing inhibition percentage decreased as time elapsed with an upper hand on TL.

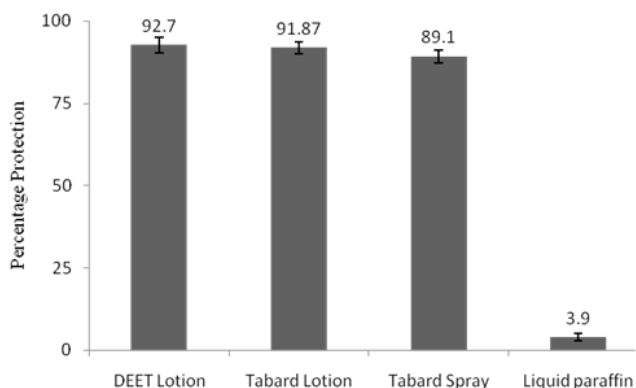
Also, laboratory Comparison of probing percentage inhibition between TS and DEET was conducted and the results were as follows; The probing inhibition percentage had no statistical difference on 0 hour ( $P=0.336$ ) after 4 hours ( $P=0.299$ ) and after 8 hours ( $P=0.826$ ) (**Figure 2**). Probing inhibition decreased as time increased.

Comparison of feeding inhibition of TL, TS and DEET not found to be statistically different among the three products at 0 hour when ( $P=0.211$ ), 4 hour ( $P=0.414$ ) and 8 hours, the difference was found significant with high feeding inhibition on Tabard lotion ( $P=0.008$ ) (**Figure 2**).

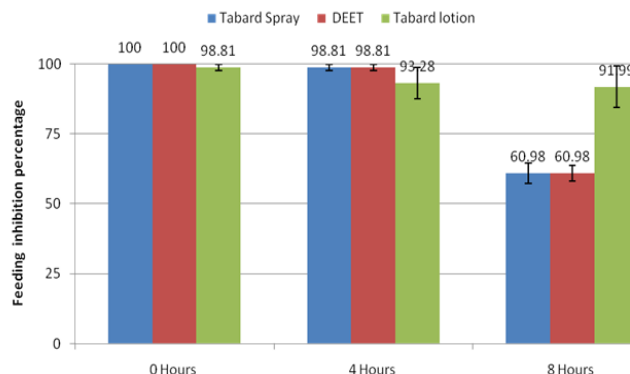
In the field trials, the comparison of number of mosquitoes collected by human landing catch in groups treated with liquid paraffin (control) was highest than in any treatment either DEET(positive control), TL or TS. This variation among six groups was found to be statistically different ( $P<0.001$ ). The comparison of protective efficiency between the Tabard treatments and DEET group was found to have no statistical significant ( $P=0.202$ ) (**Figure 3**).

## Discussion

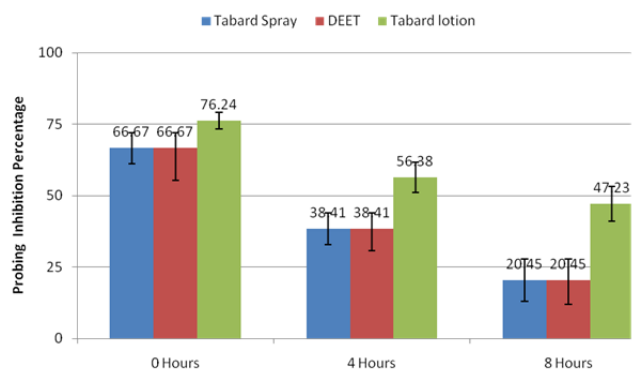
The findings of this study have revealed a high probing and feeding inhibition of the Tabard lotion, Tabard spray and DEET to be similar in laboratory and in field condition. These findings are similar to the previous study conducted comparing menthol propylene glycol carbonate against N, N-diethyl-methylbenzamide in the same study area [8]. In other studies the different formulations of repellents, mostly lotions have given more protective efficiency than other [12]. The lotion formulations have extended the protection efficacy than spray formulation due to least evaporation rate on the body surface. Similar results were observed in previous study conducted in the same field site and other parts of malaria endemic areas [7,8,13-16]. This attained protection efficacy by Tabard against *A. gambiae* s.l. is of great achievement in residual malaria transmission control. The use of topical repellent with longer protective time is advocated throughout for effective residual malaria control [17]. Since its introduction in market DEET has been protective with its residual repellent effect after application for 8 hours [6,18]. In Tanzania DEET products have found to be protective in laboratory and as well as in field situation [7-9,19]. This protective efficacy shown by different formulations in the field situation have promising additional value in existing personal protection tool for having protection efficiency of above 90%.



**Figure 1** Percentage probing inhibition shown by tabard lotion, tabard spray and gold standard deet in laboratory.



**Figure 3** Percentage protection of three treatments against wild population of *A. arabiensis*.



**Figure 2** Percentage feeding inhibition shown by tabard lotion, tabard lotion and gold standard deet in laboratory.

## Conclusion

The findings of this study suggested that, Tabard lotion and spray are additive assets in malaria vector personal protection tool box

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for residual malaria in Afro tropical areas. Wide coverage use is needed for community protection effect.

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**Author's contributions:** EJK and AMM conceived and designed the study. LJJ and VT did data collection. EJK, VT, LJJ and AMM revised this manuscript critically. All authors have agreed upon submission of this manuscript.

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