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BIO-INSECTICIDE IMPACT OF *SIDA RHOMBIFOLIA* FABRIC TREATED WITH *ALOE VERA* ON WILD *ANOPHELES GAMBIAE*

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Abstract. Malaria is transmitted to humans through the bite of infected female Anopheles mosquitoes carrying Plasmodium parasites. In Cameroon, mosquito control primarily relies on long-lasting insecticide-treated nets (LLINs), which may cause skin irritation and respiratory discomfort due to synthetic pyrethroids. This study explores a potential natural alternative: weft-knitted *Sida rhombifolia* fabrics treated with *Aloe vera* gel.

Nine (9) samples were tested, including a positive control (permethrin-treated net), a negative control (untreated net), and seven experimental fabrics: untreated *Sida rhombifolia* fabric, fabric treated with *Aloe vera*, the same fabric

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washed twice, permethrin-treated Sida fabric, and Aloe vera-treated fabrics stored for 1, 2, and 3 months.

Two WHO-standard bioassays were conducted: cone tests (3-minute exposure) and cylinder tests (15-minute exposure), using wild Anopheles gambiae populations from Yaoundé. Fabrics treated with Aloe vera showed promising mortality rates, reaching up to 22% in cone tests and 25% in cylinder tests, comparable to those of permethrin. Efficacy declined slightly over time, particularly after 3 months of storage or brief contact exposure. These findings suggest that Aloe vera-treated Sida rhombifolia textiles could serve as natural, biodegradable alternatives to LLINs, subject to further optimisation for long-term stability and field deployment.

Keywords: *Sida rhombifolia*, *Aloe vera*, natural insecticide, mosquito control, *Anopheles gambiae*, bio-fabric.

1. Introduction

Worldwide, over 3,500 mosquito species are classified into 41 genera. In Africa alone, 837 species have been documented (Clements, 1992). Malaria transmission to humans occurs solely through female mosquitoes of the genus Anopheles. Of approximately 430 Anopheles species globally, only 30 to 40 are known to transmit malaria. The disease primarily targets three major vectors that are widely distributed across sub-Saharan Africa: *Anopheles gambiae*, *Anopheles coluzzii*, and *Anopheles arabiensis* (Eleazar *et al*., 2022; Clements, 1992 and 1999; Islam *et al*., 2017; Kakou, 2021; Nsangou *et al*., 2022, 2023a, 2023b). These three species share identical morphology and belong to the same species complex, known as *Anopheles gambiae* sensu lato (Clements, 1992; Nsangou *et al*., 2023a; Yadouleton *et al*., 2018). One effective method to combat mosquito bites is the use of impregnated mosquito nets. Long-lasting impregnated mosquito nets (LLINs) in Cameroon are available in three types: Olyset Net, featuring polyethylene support impregnated with permethrin; Perma Net 3.0, supported by polyethylene and impregnated with deltamethrin; and Mag Net, made of polyester with alphacypermethrin and a PBO mixture (Nkemaja *et al*., 2024). These nets may cause adverse effects upon contact with skin or when breathing, so it is advised to leave them in the shade for 24 hours before use (Eleazar *et al*., 2024). Chemicals in the nets can lead to negative health effects, such as headaches, oxidative stress, and pollution (Oyetunji *et al*., 2024). The fibre from the bast of SR is white, flexible, soft, shiny, and has a uniform texture. The fibres of *Sida rhombifolia* are suitable for textiles (Nsangou *et al*., 2022). The gel is the transparent mucilage found in the parenchymal cells of the fresh leaf of AV (Nsangou *et al*., 2022). AV gel, with a pH of 4 to 5, contains approximately 98.5% water, with the cuticle containing about 90%. The total solid content is 0.66%, with soluble solids accounting for 0.56%, considering seasonal variations (OMS, 2017; Youssouf *et al*., 2020). The choice of knitwear for SR treated with

Aloe vera gel stems from three prior studies (Nkemaja *et al*., 2024; Nsangou *et al*., 2021a; Nsangou *et al*., 2023a). These studies indicate that textiles of plant origin with antimicrobial properties (such as cotton, jute, wool, cotton-rayon blends) are often treated with chemical agents. For example, cotton can be treated with bifenthrin to repel mosquitoes. Natural and naturally treated textiles for combating parasitic arthropods are still not fully understood. Neem, garlic, eucalyptus, lemongrass, *Aloe vera*, and *Sida rhombifolia* are all known for their insecticidal properties. Extracts from these plants, including *Aloe vera* gel, have been used in textiles and tested for antimicrobial activity. *Sida rhombifolia* fibre completely inhibits *Escherichia coli* at 2g after six hours. It also inhibits Salmonella typhi, with coatings of *Aloe vera* gel accelerating this effect. It inhibits *Pseudomonas aeruginosa* and *Vibrio cholerae* at doses of 0.5g, 1g, 1.5g, or 2g. When macerated with *Aloe vera* gel, it fully inhibits *Aeromonas hydrophila* at 1.5g over six hours, *Pseudomonas aeruginosa* at 2g over six hours, and *Vibrio cholerae* at 1.5g over three hours (Nsangou, 2020; Nsangou *et al*., 2021a). These require further experimental investigation considering environmental challenges posed by climate change, which could also open new avenues for economic growth. Since this approach might reduce reliance on pyrethroids, which are produced through an exothermic substitution of alkane hydrogens with halogens (chlorine or bromine) or via addition reactions involving halogens, requiring catalysts for alkenes and alkynes. Consistent with Nkemaja *et al*. (2024b), phytochemical screening showed the presence of compounds such as flavonoids, sterols, and polyterpenes. The diversity of compounds identified through visible and UV spectroscopy at 366 nm, as well as various reagent tests, highlights the richness of bioactive substances in the extracts (Nkemaja *et al*., 2024b). Therefore, the plant's potential to combat mosquitoes may be linked to these chemical families or their synergistic effects. This study aims to replace conventional mosquito nets with *Sida rhombifolia* nets treated with *Aloe vera* gel.

2. Materials and Methods

2.1. Impregnation of knitting *Sida rhombifolia* with *Aloe vera* gel

Nine samples were used to evaluate the activity of *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel: a mosquito net sample impregnated with permethrin or a positive control (Olyset Net), and another non-impregnated control sample or negative control (Care Plus) (MNTB). The other seven samples included a *Sida rhombifolia* knitted sample not impregnated with *Aloe vera* gel (TNT), a sample impregnated with *Aloe vera* gel (TTA), a sample impregnated with *Aloe vera* gel and washed twice (TTAL2), a sample impregnated with permethrin (TIP), a sample impregnated with *Aloe vera* gel for one month (EI1M), for two months (EI2M), and for three months (EI3M). All samples underwent cone tests. Additionally, a cylinder test was performed

considering these knits and curtains as papers impregnated with insecticide, following WHO recommendations when the impregnated dose is unknown. These tests utilised a wild field population of *Anopheles gambiae* from Yaoundé, chosen specifically to evaluate the real-world effectiveness of the knitting against field mosquitoes.

2.1.1. Washing

Washing was done manually by ISO 3758 using water at room temperature. Azure brand soap (350g) was used. Excess water was removed through manual wringing and air drying for 2 minutes, with drying carried out in the shade at room temperature. For multiple washes, the process remained the same: simply wait for drying and repeat the cycle. This indicates that the number of washes correlates with the number of days: one wash per day, two washes over two days.

2.1.2. Samples

They were used to assess the activity of *Sida rhombifolia* knitted fabric (the sample is displayed in Fig. 1) impregnated with *Aloe vera* gel: a mosquito net sample impregnated with permethrin or positive control (*Olyset Net*), and another non-impregnated control sample or negative control (*Care plus*) (MNTB) and the other 7 samples (a *Sida rhombifolia* knitted sample not impregnated with *Aloe vera* gel (TNT), a *Sida rhombifolia* knitted sample impregnated with *Aloe vera* gel (TTA), a *Sida rhombifolia* knitted sample impregnated with *Aloe vera* gel and washed twice (TTAL2), a *Sida rhombifolia* knitted sample impregnated with permethrin (TIP), a sample impregnated with *Aloe vera* gel for one month (EI1M), an impregnated sample impregnated with *Aloe vera* gel for 2 months (EI2M) and a sample impregnated with *Aloe vera* gel for 3 months (EI3M).

Fig. 1 – Samples to be tested: the type of knitting of *Sida rhombifolia*.

These samples were subjected to cone tests. In addition to this test, the cylinder test was carried out by considering these knits and curtains as papers impregnated with insecticide.

This is a WHO recommendation when the dose of the impregnated material is not known. Said tests were carried out with a wild field population (Yaoundé) of *Anopheles gambiae*. The choice of the wild field population of Yaoundé was made with the sole aim of controlling the reality of the activity of the knit against the field mosquito.

2.2. Collection of immature stages and laboratory rearing

Anopheles gambiae (suspected resistance) populations for insecticide sensitivity testing were collected in the larval stage from natural (puddles, ponds, lakes) and artificial (water reservoirs, pits, tyre tracks, and tin cans) breeding sites around the University of Yaoundé 1 during the period from 17 to 28 August 2024 (Chonoibon *et al*., 2008). *Anopheles gambiae* larvae and nymphs were collected using the dipping method (Yadouleton *et al*., 2018) with handled ladles (Fig. 2a). These larvae and nymphs were collected beneath plants bordering watercourses. A breeding site is deemed positive if at least one Anopheles larva is found; it is considered negative if no larvae are collected after 20 to 30 minutes of sampling (Merdya *et al*., 2022). The collected larvae and nymphs were transferred into 1-litre plastic bottles filled with water from the breeding site and transported to the Laboratory of Parasitology and Ecology, Department of Animal Biology and Physiology, Faculty of Sciences, University of Yaoundé 1, for their rearing (Merdya *et al*., 2022). These larvae were raised in water from the breeding sites and were fed daily (Yadouleton *et al*., 2018) (Fig. 2c). Adult mosquitoes were fed in 10-litre basins open to the surroundings, using honey on cotton. Anopheles gambiae are identifiable by the horizontal position of their larvae in the water, and when mature, they have a pair of long, segmented antennae. Rearing took place at a room temperature of 22°C and a pressure of 1024 hPa.

Fig. 2 – Collection (a), transport (b) and rearing (c) of immature stages of *Anopheles gambiae*.

2.3. Cone test

The cone test was conducted per the WHO protocol (WHO, 1998). In each cone, eight young female mosquitoes (2-5 days old) were introduced and

left in contact with the knitted fabrics for 3 minutes. They were then removed from the cones and transferred to sterile cups covered with a veil, placed on cotton discs soaked in natural honey, used for feeding the mosquitoes. After 24 hours of observation, mortality rates were recorded for each batch of mosquitoes. Mortality for the test and control samples is calculated by adding the number of dead mosquitoes and expressing the result as a percentage of the total number of mosquitoes

exposed (equation 1).

$$Observed\ mortality = \frac{Number\ of\ dead\ mosquitoes}{Total\ exposed} x100 \quad (1)$$

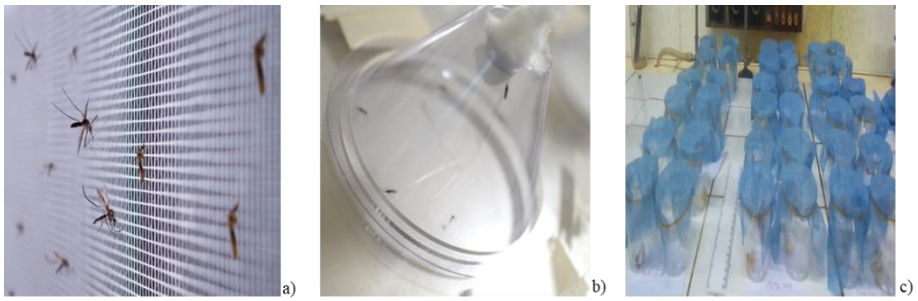

Fig. 3 – a) Mosquito culture tank, b) Mosquitoes kept in a cone, c) mosquitoes stay in cups supplied with natural honey.

2.4. Cylinder tests

This test assesses the presence of insecticide on impregnated substrates. It is used with the cone test to provide additional information on the efficacy of knitted fabrics impregnated with *Sida rhombifolia*. The tests were carried out using fragments of impregnated curtains and knitwear cut into 5cm-by-5cm fragments and used as insecticide-impregnated papers. The tests followed the WHO protocol in a cylindrical tube (WHO, 1998). The mosquitoes' exposure time to the impregnated curtains was 15 minutes, and the observation time before reading the results was 24 hours. After the tests, the dead and live mosquitoes were separated. Considering the WHO scale, any mosquito population was considered sensitive to the insecticide when the mortality in the test was greater than or equal to 97%. The population was described as resistant when the mortality was less than 80%. Resistance was suspected between the two values. The same apparatus as in Fig. 3 was used, with the cone replaced by the cylindrical exposure chamber (see Fig. 4)

Fig. 4 – Mosquitoes stay in the cylinder.

To find the replicate mean, it adds up replicates 1, 2, 3 and 4 and divides by 4. The standard deviation is equal to the sum of the replicates squared divided by 4 minus the mean squared.

3. Results

3.1. Cone test

320 mosquitoes were used for testing. The nine (9) samples to be tested, namely: one sample of net impregnated with permerine or positive control (Olyset Net), and another sample of unimpregnated control or negative control (*Care plus*) (MNTB) and the other eight samples (one sample of *Sida rhombifolia* knitted fabric not impregnated with *Aloe vera* gel (TNT), one sample of *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel (TTA), a sample of *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel and washed twice (TTAL2), a sample of *Sida rhombifolia* knitted fabric impregnated with permethrin (TIP), a sample impregnated with *Aloe vera* gel for one month (EI1M), a sample impregnated for 2 months (EI2M) and a sample impregnated for 3 months (EI3M). Bioassay results after four repetitions of the Cone tests showed that the average induced mortality rate after a 3-minute contact was 63.4% (Table 1).

Table 1

Mortality of Anopheles gambiae populations from the cone test observed after 3 minutes of contact with treated and untreated knitwear, as well as controls

Morbidity (%) after 3 minutes of contact									
Replicate	MBT	MNTB	TNT	TTA	TIP	TTAL2	EI1M	EI2M	EI3M
1	25	12.5	16.75	25	22	18.75	22	12.5	18.75
2	25	10.75	17.75	22	22	25	12.5	8.25	12.5
3	22	8.25	12.5	22	18.75	18.75	22	18.75	3
4	12.5	3	15.75	15.75	18.75	18.75	18.75	12.5	12.5
Average	21	8.75	15.75	22	20.25	22	18.75	13	11.75
SD	02	01.75	02.00	01	01.75	01	01.75	01.75	02.75

SD: Standard deviation

MBT: Net impregnated with permerine or positive control (Olyset Net), MNTB: Net unimpregnated control or negative control

TNT: *Sida rhombifolia* knitted fabric not impregnated with *Aloe vera* gel (*Care plus*), one sample of *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel, TTA: *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel, TTAL2: *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel washed twice, TIP: *Sida rhombifolia* knitted fabric impregnated with Permetrin EI1M: *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel for one month. EI2M: *Sida rhombifolia* knitted fabric impregnated for 2 months, EI3M: *Sida rhombifolia* knitted fabric impregnated for 3 months.

Average values facilitate comparison of the different tested conditions. MBT (positive control): high mortality (21%), as expected. MNTB (negative control): low mortality (8.75%), confirming it has no effect. TNT (knitted fabric not treated with *Aloe vera* gel): moderate mortality (15.75%), indicating a slight insecticidal effect of Sida rhombifolia knitted fabric without Aloe vera gel. TTA (Sida rhombifolia knitted fabric impregnated with *Aloe vera* gel) and TIP (Sida rhombifolia knitted fabric impregnated with permethrin) exhibited the highest mortality (22%), demonstrating a significant protective effect. EI 1 M, EI 2 M and EI 3 M (gel impregnated for 1, 2 and 3 months): mortality decreased over time (18.75%, 13%, 11.75%), suggesting a gradual decline in efficacy. Standard deviations are generally low (1 to 2.75%), indicating consistent and reliable data. For EI 3 M, the slightly higher standard deviation (2.75%) may reflect increased variability related to the gel's age. The impregnated knitted fabrics (TTA and TIP) show high mortality rates (22%), similar to the positive control (MBT), confirming their effectiveness in a short timeframe. *Aloe vera* gels lose effectiveness over time (EI 1 M> EI 2 M> EI 3 M). MNTB (negative control) exhibited minimal mortality (8.75%), reaffirming the absence of an insecticidal effect. TNT (knitted fabric impregnated with Sida rhombifolia) resulted in slightly higher mortality (15.75%), possibly due to mechanical effects or other

properties of Sida rhombifolia. Mortality rates are lower than in the cylinder test, reflecting a limited effect due to the short contact time (3 minutes). Maximum efficacy reached 22% with the treatment of *Aloe vera* gel and permethrin. Comparing this to Yadouleton's (2018) work on quality control of bifenthrin-impregnated curtains for use and dissemination in Benin, which showed that in cone bioassays, the mortality after 3 minutes of exposure over 2 hours was 48.85% for the susceptible strain and 6.96% for the wild strain.

3.2. Cylinder test

As with the cone test, 320 mosquitoes were used to perform this test on the nine (9) samples to be tested. The purpose of the results of this cylinder test is to confirm the cone test. As with the cone test, 320 mosquitoes were used to perform this test on the nine (9) samples to be tested. The bioassay results after four replicates of the cylinder tests are shown in Table 2 below.

Table 2

Mortality rate of Anopheles gambiae populations following the cylinder test observed after 15 minutes of contact with treated knitwear

Morbidity (%) after 3 minutes of contact									
Replicate	MBT	MNTB	TNT	TTA	TIP	TTAL2	EI1M	EI2M	EI3M
1	25	18.75	22	25	25	25	25	25	21
2	25	12.5	25	25	25	25	25	25	25
3	25	15	22	25	25	25	25	25	25
4	25	12.5	22	25	25	25	25	25	25
Average	25	14.75	23.5	25	25	25	25	25	23.25
SD	00	01	00.5	00	00	00	00	00	00.25

SD: Standard deviation

MBT: Net impregnated with permethrin or positive control (*Olyset Net*), MNTB: Net unimpregnated control or negative control

TNT: *Sida rhombifolia* knitted fabric not impregnated with *Aloe vera* gel, one sample of *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel, TTA: *Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel, TTAL2: *Sida rhombifoli*a knitted fabric impregnated with *Aloe vera* gel washed twice, TIP: *Sida rhombifolia* knitted fabric impregnated with permetrin EI1M*: Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel for one month. EI2M*: Sida rhombifolia* knitted fabric impregnated for 2 months, EI3M: *Sida rhombifolia* knitted fabric impregnated for 3 months.

4. Discussion

MBT (positive control): high mortality (25%). MNTB (negative control): low mortality (8.75%), confirming its lack of insecticidal effect. TNT (untreated knitted fabric): mortality (23.5%), serving as a control. TTA (*Sida rhombifolia* knitted fabric impregnated with *Aloe vera* gel), TIP (*Sida rhombifolia* knitted fabric impregnated with permethrin), and TTAL2 exhibited the highest mortality (25 %), demonstrating a significant protective effect. EI1M, EI2M and EI3M (gel impregnated for 1, 2 and 3 months: mortality decreased with time (25%, 25%, 23%), respectively. Standard deviations show almost zero variability for all conditions, indicating high consistency. Comparison of knitted fabric impregnated with *Aloe vera* gel (TTA, TTAL2, E1M, E2M) and permethrin-impregnated knitted fabric (MBT, TIP) shows an almost equivalent mortality rate (25%), except after 3 months' storage (E3M: 23.25%). Aloe vera gel remains effective even after two washes (TTAL2: 25%). Conservation remains high for knitwear stored for 1 and 2 months. However, it decreased after 3 months. Mortality rates are lower for negative controls (MNTB) and untreated knitted fabrics (TNT), confirming that the effect observed is due to the treatment. The high mortality rates observed in all treated conditions were likely due to the use of longer contact times. The maximum efficacy observed was 25% for the treated samples (*Aloe vera* gel and permethrin). We compared our findings with the work of Yadouleton (2018) on the quality control of Bifenthrin-impregnated curtains, which shows that in cone bioassays, the mortality rates obtained after 24 hours were 16.83% and 7.1% for the sensitive strain and the wild strain, respectively. *Aloe vera* gel demonstrated comparable efficacy to permethrin in both tests: the cone test (3 minutes) showed 22% efficacy, slightly lower but still promising, while the cylinder test (15 minutes) reached 25%, matching permethrin. This suggests it could be a compelling natural alternative. In the cylinder test (15 minutes), mortality remained steady at 25% for E 1 M (1 month) and E 2 M (2 months), but decreased slightly to 23.24% at E 3 M (3 months). Conversely, in the cone test (3 minutes), mortality rates declined progressively: 22% (1 month), 18.75% (2 months), and 11.75% (3 months). These results indicate that the gel's efficacy diminishes over storage time, especially with shorter contact durations. For the cone test, efficacy slightly declined after two washes (20- 25%), whereas washing the knitted fabric twice did not affect efficacy in the cylinder test, which remained at 25%. Unimpregnated knitted fabrics showed the lowest mortality rates: in the cylinder test (15 minutes), 15.75% (MNTB) and 23.5% (TNT), and in the cone test (3 minutes), 8.75% (MNTB) and 15.75% (TNT). This confirms that the high mortality observed with knitted fabrics is attributable to the treatment applied. Future testing on the laboratory's sensitive strain is necessary to compare results based on the OMS scale, which requires at least 80% efficacy for materials impregnated with sensitive strains. Although essential oils have gained popularity in pest control due to their biodegradability and ecological

safety, concerns persist regarding their stability (Akinyemi *et al*., 2024). The resistance of Anopheles mosquitoes, such as Anopheles gambiae, to insecticides is notable; for instance, resistance to permethrin at 0.25% has been identified in Côte d'Ivoire (Chandre *et al*., 1999). Resistance has also been observed against deltamethrin in three West African countries - Benin, Burkina Faso and Senegal. (Chonoibon *et al*., 2008) as well as in Cameroon and Botswana (Yadouleton *et al*., 2010; Ngouyamsa *et al*., 2020). Tests conducted on female *Anopheles gambiae* following WHO protocols involved observing mosquito mortality during exposure to insecticide-treated nets, with the knock-down effect serving as an initial indicator of resistance (Musaka *et al*., 2014). The decline in knock-down effect preceded mortality, making it a valuable early indicator of resistance in Anopheles gambiae to permethrin (Chandre *et al*., 1999).

5. Conclusions

This study aimed to evaluate the mortality effects of Aloe vera-treated Sida rhombifolia weft knitted fabric on wild Anopheles gambiae. Aloe vera gel demonstrated comparable efficacy to permethrin in both tests: in the cone assay (3 minutes), it achieved 22% mortality slightly lower but still promising and in the cylinder assay (15 minutes), it reached 25% maximum efficacy, equivalent to permethrin. This makes it an interesting natural alternative. The cylinder test (15 minutes) showed a consistent mortality rate of 25% for E 1 M (1 month) and E 2 M (2 months), but a slight decrease to 23%, 24% at E 3 M (3 months). For the cone test (3 minutes), mortality rates declined progressively: 22% at 1 month, 18. 75% at 2 months, and 11.75% at 3 months. *Aloe vera* gel exhibited reduced insecticidal efficacy after prolonged storage, particularly in short-term exposure tests. In the cone assay, efficacy slightly decreased after two washes (20-25%), while washing the knitted fabric twice did not significantly affect efficacy in the cylinder test (25%). Untreated knitted fabrics showed the lowest mortality rates across both tests: in the cylinder (15 minutes), 15.75% (MNTB) and 23.5% (TNT); in the cone (3 minutes), 8.75% (MNTB) and 15.75%(TNT). This confirms that the high mortality observed with treated fabrics is attributable to the treatment applied. *Aloe vera* gel displays comparable efficacy to permethrin in controlling Anopheles gambiae, even after multiple washes of *Aloe vera* gel-treated *Sida rhombifolia* knitted fabric or storage periods of 1-2 months. Its efficacy slightly declines after 3 months, suggesting that *Aloe vera* gel-treated *Sida rhombifolia* knitted fabric could serve as a natural alternative to LLINS in combating these mosquitoes, although periodic reapplication remains necessary. Both tests indicate that *Aloe vera* acts quickly (within 3 minutes), but its full effect develops after prolonged contact (15 minutes). More research is needed to enhance the gel's stability and durability for practical field use. Additional tests should focus on improving *Aloe vera* gel's stability for extended use and investigating its mechanisms of action (e.g., direct toxicity, repulsion, etc.).

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IMPACTUL BIO INSECTICIDULUI *SIDA RHOMBIFOLIA* ASUPRA ŢESĂTURILOR TRATATE CU *ALOE VERA* ÎMPOTRIVA *ANOPHELES GAMBIAE* SĂLBATICĂ

(Rezumat)

Malaria se transmite oamenilor prin mușcătura țânțarilor femele *Anopheles* infectate, purtătoare de paraziți *Plasmodium*. În Camerun, combaterea țânțarilor se bazează în principal pe plase tratate cu insecticide de lungă durată (LLIN), care pot provoca iritații ale pielii și disconfort respirator din cauza piretroizilor sintetici. Acest studiu explorează o alternativă naturală potențială: țesături tricotate din *Sida rhombifolia* tratate cu gel de *Aloe vera*.

Au fost testate nouă probe. Un control pozitiv (plasă tratată cu permetrin), un control negativ (plasă netratată) și șapte țesături experimentale: țesătură netratată din *Sida rhombifolia*, țesătură tratată cu *Aloe vera*, aceeași țesătură spălată de două ori, țesătură *Sida* tratată cu permetrin și țesături tratate cu *Aloe vera* depozitate timp de 1, 2 și 3 luni.

Au fost efectuate două teste biologice standard ale OMS: teste cu con (expunere de 3 minute) și teste cu cilindru (expunere de 15 minute), utilizând populații sălbatice de *Anopheles gambiae* în Yaoundé. Țesăturile tratate cu *Aloe vera* au prezentat rate de mortalitate promițătoare: până la 22% în testele cu con și 25% în testele cu cilindru, comparabile cu permetrina. Eficacitatea a scăzut ușor în timp, în special după 3 luni de depozitare. Aceste rezultate sugerează că suporturile textile *Sida rhombifolia* tratate cu *Aloe vera* ar putea servi ca alternative naturale, biodegradabile la LLIN-urile, sub rezerva optimizării ulterioare pentru stabilitatea pe termen lung și implementarea pe teren.