PermaNet® 3.0

A pyrethroid-PBO LLIN like no other

Soft nets. Strong protection. PermaNet®

PermaNet® 3.0 by VESTERGAARD

A pyrethroid-PBO LLIN like no other

PermaNet 3.0
second generation LLIN
with controlled release design

PermaNet 3.0 long-lasting insecticidal mosquito net (LLIN) is a pyrethroid-PBO LLIN like no other. It provides long-term protection against pyrethroid-resistant mosquitoes. The combination of PBO with the pyrethroid insecticide, deltamethrin, enhances the effect of the insecticide and provides higher mosquito killing compared to pyrethroid-only nets.

Unlike other pyrethroid-PBO nets, PermaNet 3.0 has proven sustained efficacy, backed by multi-year studies and post-market monitoring, in real-life conditions in Sub-Saharan Africa and Asia.

The blue roof features a unique *controlled release design* to ensure that the right ratio of ingredients continues to migrate to the fabric surface throughout the lifetime of the net. It is ideal for communities living in areas where malaria vectors are resistant to pyrethroids.

Second generation LLIN fighting widespread resistance

PermaNet 3.0 was our first response to the calls made by malaria control programmes for innovative new tools that fight transmission and insecticide resistance. Backed by ten years of rigorous research in Sub-Saharan Africa, PermaNet 3.0 was the first pyrethroid-PBO LLIN on the market.

PermaNet 3.0 participated in one of two randomised control trials and the successful results allowed WHO to establish a recommendation for pyrethroid-PBO nets. PBO LLINs have become a category of nets that have since been widely adopted as part of malaria control progress in Africa in the face of pyrethroid resistance.

Key elements of PermaNet 3.0 controlled release design

- Impregnated with an optimal concentration of PBO to guarantee availability through 3 years of proper use
- The right ratio of PBO and pyrethroid: 6.25 times more PBO than deltamethrin for optimal protection
- Thinner yarns create a denser barrier and higher chemical load
- A blue roof with a patented slow-release formula
- Soft sides and breathable mesh for user comfort

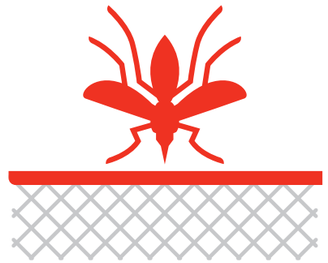
Controlled release design for precise equilibrium

Utilising a unique controlled release design, PermaNet 3.0 retains and releases piperonyl butoxide (PBO) in a patented, slow release formulation. By providing a steady availability of insecticide (deltamethrin) and PBO on the yarn surface, it assures bioefficacy over a period of three years.

Vestergaard's PermaNet 3.0 LLIN was designed to take into account the properties of its two ingredients – deltamethrin and PBO. Our controlled release design works by releasing the optimal ratio of ingredients from within the yarn over time ensuring bioavailability throughout the net's intended three-year lifetime. This overcomes the loss of active ingredients which occur from daily handling, washing and daylight.

Why the unique construction?

Behavioural studies on mosquitoes show that a mosquito's first contact with an LLIN is on the roof. Thus, the roof of PermaNet 3.0 is designed with a polyethylene roof panel incorporated with deltamethrin and PBO to target mosquitoes with metabolic resistance. With the sides made from the softest and most breathable polyester mesh, PermaNet 3.0 offers the highest level of user comfort, increasing the likelihood of utilisation.



What is PBO?

Piperonyl butoxide (PBO) is not an insecticide. It acts as a synergist, completely or partially restoring the neurotoxic effect of the pyrethroid on the mosquito. By utilising a combination of a pyrethroid insecticide and PBO, PermaNet 3.0 increases the efficacy of deltamethrin by blocking the metabolic enzymes that the mosquito uses to break down the insecticide.

Evidence of long-term efficacy

PermaNet 3.0 long-term scientific evidence

A substantial body of evidence demonstrates the increased efficacy of PermaNet 3.0 against pyrethroid resistant malaria mosquitoes in Sub-Saharan Africa.

Scientific publications include:

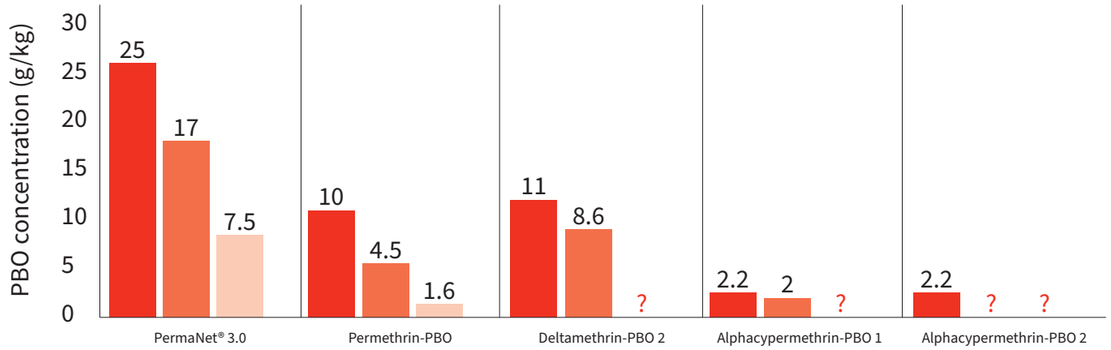
- Randomised controlled trials
- Laboratory and semi-field trials
- Community studies
- Post-market surveillance of used nets

Epidemiological results

The randomised control trial in Uganda assessed malaria prevention for up to 2 years and showed 20% higher protection from malaria (i.e., reduction of malaria prevalence by 20% in the population covered by pyrethroid-PBO nets versus pyrethroid-only nets) in a high pyrethroid resistance setting (Gleave *et al*., 2021; Staedke *et al*., 2020).

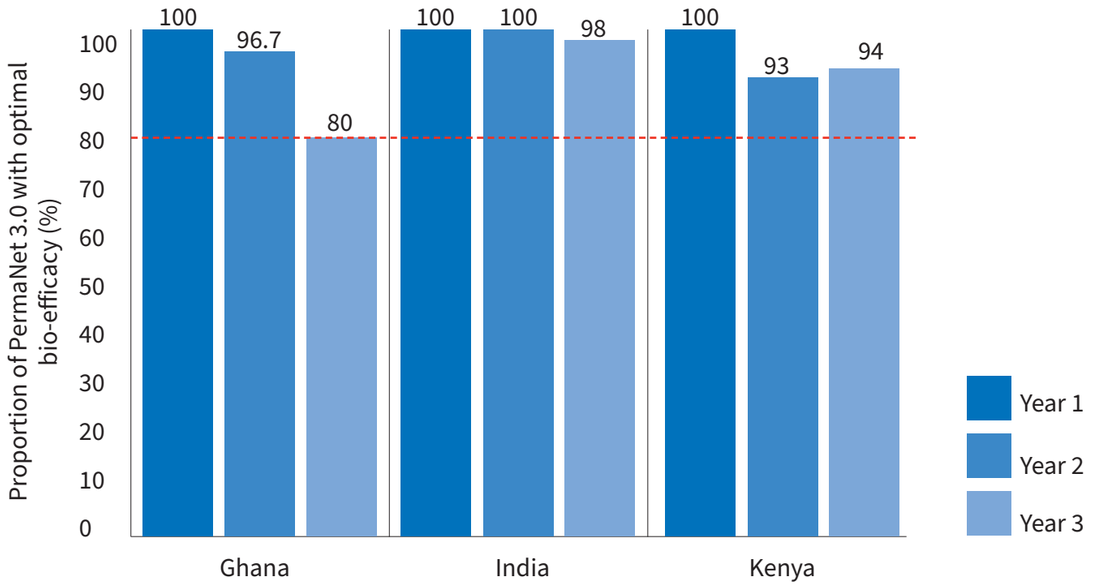
Importance of PBO concentration and gradual release

Properties driving durability of PBO-LLINs includes the starting concentration and the release rate of PBO on the net. The optimal PBO concentration of the PermaNet® 3.0 was determined to be 25.0 g/kg. In addition, controlled release rates must be fast enough for replenishment of active ingredients that are lost from the surface, but also slow enough to ensure the bioavailability of both ingredients during the expected lifetime of the LLIN. As a proxy of three years of use, lab and semi-field (hut) studies assess LLINs washed 20 times. However, in typical net usage, PBO is lost in ways other than washing such as evaporation and handling. Therefore, it is essential to verify that enough PBO is gradually released over three years in real world condition.



Proven long-term efficacy

An LLIN must be expected to demonstrate that it is long-lasting. PermaNet 3.0 has been evaluated based on the WHO guidelines for laboratory and field testing of LLINs (WHO, 2013), which included an assessment of bio-efficacy, net survivorship and fabric integrity for 3 years under field conditions. The study sites were in India, Kenya and Ghana and covered a variety of geographical use conditions (Dadzie et al., 2018; Vulule et al., 2018; Raghavendra et al., 2017).
The field trials demonstrated long-term bio-efficacy as well as evidence of good physical durability and survivorship of LLINs.



PermaNet post market surveillance:

Collecting post-market data is vital to monitor our LLINs over their intended lifetime of three years. By monitoring our mosquito nets, we are able to verify that the design intent of PermaNet 3.0 is being fulfilled after long-term use.

We collected long-term evidence from Uganda, Malawi and Tanzania. Variability was expected, depending on net use environment and use conditions, in the same way as other monitoring studies

- In all countries, there was PBO remaining on PermaNet 3.0 roof samples, consistent with the intended usage of three years
- PermaNet 3.0 nets were still more efficacious than a pyrethroid only net, PermaNet 2.0, against pyrethroid-resistant mosquitoes

At a glance

PermaNet 3.0 is setting a new standard in African countries with high malaria transmission. It is registered across malaria-endemic countries and is deployed as part of a customised approach to vector control.

1. PermaNet 3.0 provides increased efficacy and protection against pyrethroid-resistant mosquitoes.

2. It is a long-lasting insecticidal net combining deltamethrin and piperonyl butoxide, also known as PBO – a synergist which overcomes mosquitoes' resistance to insecticides.

3. It is a proprietary mosquito net that features a unique controlled-release design. This ensures that the active ingredients continue to migrate to the fabric's surface for the lifetime of the net.

4. PermaNet 3.0 is the only PBO net with long-term field performance data. This data has proved that the controlled-release design maintains effective levels of PBO and insecticide in real-life conditions.

Product specifications

	Roof	Sides
Material	100% polyethylene	100% polyester
Yarn	100 denier	100 denier
Deltamethrin content	4.0 g/kg + 25%	2.1 g/kg +25%
PBO content	25 g/kg + 25%	Not applicable
Bursting strength	Min 300 kPa	Min 350 kPa
Mesh	Minimum 15 holes/cm^2	Min 24.0 holes/cm^2
Available colour	Blue	White, blue
WHO specification	https://extranet.who.int/pqweb/vector-control-product/permanet-30	
WHO PQ reference	005-002	

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Customer support

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