PermaNet® Dual

A novel vector control tool in the fight against malaria

Soft nets. Strong protection. PermaNet®

PermaNet® Dual by VESTERGAARD

PermaNet®
Dual by VESTERGAARD

Introducing PermaNet Dual our new dual active ingredient LLIN

Introducing the 3rd generation of LLIN with a new mode of action

PermaNet Dual is a long-lasting insecticidal net (LLIN) that provides the highest protection against pyrethroid-resistant mosquitoes. PermaNet Dual combines two insecticides with two modes of action, chlorfenapyr and deltamethrin. This type of LLIN has proven to be the most effective type of mosquito net for people living in areas with high malaria prevalence and high pyrethroid resistance.

The launch of PermaNet Dual opens up access to the new dual active ingredient LLIN segment and will accelerate the deployment of a new generation of tools to achieve sustained malaria control and faster malaria elimination.

A dual active ingredient net offering the highest level of protection

PermaNet Dual has been developed in the face of widespread pyrethroid resistance in mosquitoes and plateauing gains in the fight against malaria. PermaNet Dual combines the pyrethroid, deltamethrin with the pyrrole, chlorfenapyr. These active ingredients kill resistant mosquitoes more effectively by combining two different modes of action.

It is intended for a targeted distribution in areas where mosquitoes exhibit high levels of resistance conferred by multiple resistance mechanisms. It offers the highest level of protection and in regions where the efficacy of pyrethroid and pyrethroid-PBO LLINs is limited.

Laboratory tests and experimental hut trials have proven PermaNet Dual kills up to 70%* more mosquitoes than the pyrethroid-PBO nets bringing vital extra support in areas where resistance is highest.

Driven by technology, designed with the users in mind

PermaNet Dual is a multifilament polyester net using Vestergaard's latest proprietary technology for the application of the insecticidal impregnation. It contains two insecticides, chlorfenapyr and deltamethrin. Like PermaNet® 2.0 and PermaNet® 3.0, it offers the highest level of user comfort, made from the softest, most breathable polyester mesh, thus increasing the likelihood of utilisation.

*Depending on mosquito species and insecticide resistance profiles

Answering the call for innovation and accelerating the deployment of new generation nets

LLINs are a powerful and effective tool in malaria prevention but the disease, spread by the *Anopheles* mosquito, remains a major threat in the face of widespread pyrethroid resistance. Increased access to LLINs was the key factor contributing to an estimated 69% of the averted malaria cases between the years 2000 and 2015 (Bhatt *et al.* 2015). Since then, gains against malaria have stagnated with widespread pyrethroid resistance partly implicated.

As a result, WHO and the malaria community called on global health partners to step up the fight with better-targeted interventions, new tools and increased funding to change the global trajectory of the disease and reach internationally agreed targets.
They specifically highlighted the need for novel and more efficacious vector control tools.

PermaNet Dual is Vestergaard's response to this urgent call for innovation and signals a major step forward in the fight against malaria. PermaNet Dual is the second chlorfenapyr - pyrethroid net on the market and opens up the opportunity to accelerate the deployment of new generation nets. The overall PermaNet manufacturing platform will enable us to produce PermaNet Dual at scale, thereby supporting the expansion of the dual active ingredient net segment.

What is chlorfenapyr?

Chlorfenapyr is in the pyrrole class of insecticides, adopted to combat mosquitoes in public health. Its mode of action is new to malaria vector control. Unlike pyrethroids, pyrroles are not neurotoxic. Instead, they disrupt cellular respiration and oxidative phosphorylation in the mosquito's mitochondria. Essentially, they deprive mosquitoes of much-needed cellular energy, resulting in their death. Chlorfenapyr's unique mode of action makes it unlikely to show cross-resistance in mosquitoes that are resistant to currently registered public health insecticides.

Dual mode of actions, maximum protection

PermaNet Dual is a dual active ingredient mosquito net that controls mosquito populations in two ways.

Deltamethrin is an insecticide belonging to the pyrethroid family. It plays a key role in controlling malaria vectors and is used in the manufacture of standard LLINs.

Chlorfenapyr offers a new mode of action compared to pyrethroids. After absorption into the mosquito body, chlorfenapyr is converted into its toxic form within the mosquito cells.

This disrupts their energy production, resulting in mosquito death over 1-3 days.

The new nets are expected to achieve a significant reduction of malaria indicators, in line with randomised control trial results.

Positive outcomes of trials in Tanzania of a chlorfenapyr-pyrethroid dual active ingredient net

Outcome	Results at 24 months vs. pyrethroid-only group	Meaning
Malaria prevalence in children 6 months to 10 years old	**55% reduction**	The likelihood of young children contracting malaria has more than halved
Incidence of clinical malaria in children 6 months to 10 years old	**44% reduction**	An additional 40% of children have been protected from developing clinical malaria
Reduction number of mosquitoes in households	**85% reduction**	Significantly lowers the risk of mosquito presence in households

Source: Mosha *et al*, 2022

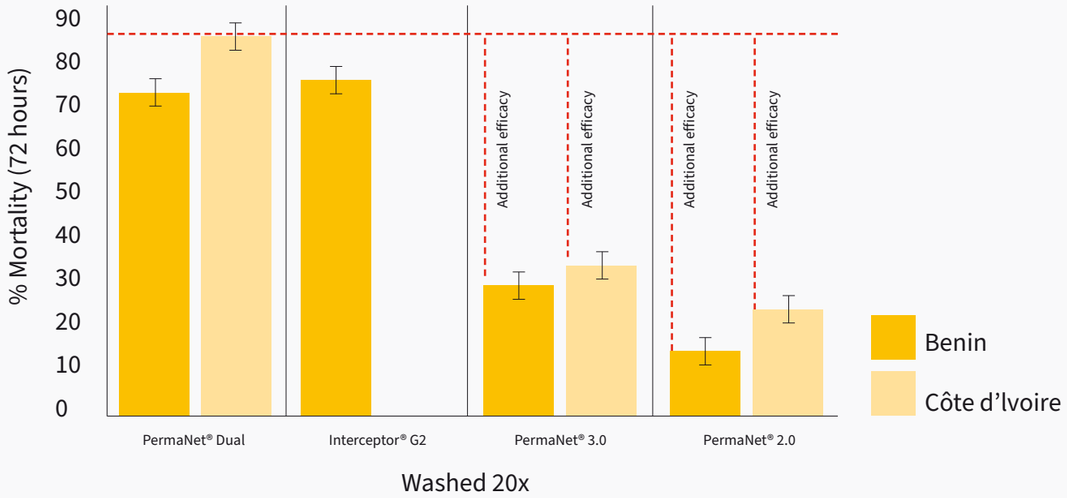
PermaNet Dual efficacy data

Studies on the efficacy of PermaNet Dual were conducted in the laboratory (Moore *et al.,* 2021; Ngufor *et al.* 2021) and experimental hut studies in Benin (Ngufor *et al*. 2021) and Cote D'Ivoire (Zahouli *et al.,* 2021).

The studies demonstrated increased efficacy of PermaNet Dual compared to pyrethroid-only and PBO-pyrethroid LLINs, against host-seeking, pyrethroid-resistant malaria mosquitoes. The studies also showed that efficacy was retained for up to 20 washes, which is the current WHO proxy for three years of field use. Non-inferiority analysis showed the performance of PermaNet Dual was similar to that of a pyrethroid-chlorfenapyr LLIN that was shown to provide a >50% reduction in malaria parasite prevalence, in a setting of high pyrethroid resistance.

- Studies were conducted across multiple sites in Benin, Côte d'Ivoire and Tanzania, between 2020 and 2021.
- PermaNet Dual was shown to be effective at killing host-seeking, pyrethroid-resistant malaria vectors in West and East Africa.
- Efficacy is retained for up to 20 washes.

PermaNet Dual efficacy studies



Two semi-field experimental hut studies with highly resistant *An. gambiae s.l.* in West Africa

Additional lab studies:
- Cone & Tunnel
- Mosquito species *An. Arabiensis* in East Africa

At a glance

PermaNet Dual is our latest product in a line of pioneering innovations, each one developed over time, in response to different requirement profiles. Launched in 2022, PermaNet Dual, with its dual mode of action, introduces better bioefficacy against highly resistant mosquito populations, bringing vital support in areas where resistance is highest.

1. PermaNet Dual is Vestergaard's first dual active LLIN and offers the highest protection against pyrethroid-resistant mosquitoes.

2. PermaNet Dual combines two insecticidal modes of action – chlorfenapyr, a non-pyrethroid insecticide, and deltamethrin.

3. Laboratory tests and experimental hut trials have proven that PermaNet Dual kills up to 70%* more mosquitoes than pyrethroid-PBO nets.

4. Covers the efficacy gap where the efficacy of pyrethroid and pyrethroid-PBO LLINs is limited.

5. Designed to combat pyrethroid-resistant mosquitoes showing multiple resistance mechanisms.

6. PermaNet Dual is the second chlorfenapyr pyrethroid net on the market and opens up the opportunity to accelerate the implementation of new generation nets.

*Depending on mosquito species and insecticide resistance profiles

Technical specifications

	PermaNet Dual Vestergaard®	Chlorfenapyr & alpha-cypermethrin LLIN
Pro-insecticide: Chlorfenapyr	200 mg/m²	200 mg/m²
Insecticide: Pyrethroid	Deltamethrin, 84 mg/m²	Alpha-cypermethrin, 100 mg/m²
Material	100% Polyester	100% Polyester
Yarn	100 denier	75 or 100 denier
Insecticide application	Coated	Coated
Mesh	Minimum 24 holes/cm²	Minimum 24 holes/cm²
Fabric Weight	40 g/m²	40 g/m²
Shelf lifetime (Storage)	2 years at max 40°C	
WHO Specification:	https://extranet.who.int/pqweb/vector-control-product/permanet-dual	
PQT/VC Ref Number:	P-03228	

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