

Supplementary information

PermaNet Dual, a new deltamethrin-chlorfenapyr mixture net, shows improved efficacy against pyrethroid-resistant *Anopheles gambiae sensu lato* in southern Benin

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Table S1: Non-inferiority and superiority analyses comparing the effect of PermaNet Dual to Interceptor G2, PermaNet 2.0 and PermaNet 3.0 for mosquito mortality and blood-feeding outcomes in experimental huts.

		Superiority assessments				Non-inferiority assessment	
		PermaNet 2.0	PermaNet Dual	PermaNet 3.0	PermaNet Dual	Interceptor G2	PermaNet Dual
Mortality (primary endpoint)	Total collected	1393	1255	1486	1255	1292	1255
	Total dead	241	951	599	951	1021	951
	Mortality (%)	17.3	75.8	40.3	75.8	79.0	75.8
	Odds ratio	–	18.012	–	5.564	–	0.878
	Std. error (on log odds scale)	–	1.900	–	0.531	–	0.089
	P-value	–	<0.001	–	<0.001	–	0.205
	95% CIs	–	14.645–22.148	–	4.614–6.709	–	0.719–1.073
	WHO efficacy criteria	–	Significantly higher (p<0.05)	–	Significantly higher (p<0.05)	–	Lower 95% CI >0.7
	Conclusion	–	Superior	–	Superior	–	Non-inferior
Blood-feeding (secondary endpoint)	Total blood-fed	705	433	348	433	339	433
	Blood-feeding (%)	50.6	34.5	23.4	34.5	26.2	34.5
	Odds ratio	–	0.495	–	1.578	–	1.424
	Std. error (on log odds scale)	–	0.044	–	0.151	–	0.138
	P-value	–	<0.001	–	<0.001	–	<0.001
	95% CIs	–	0.415–0.590	–	1.308–1.903	–	1.177–1.723
	WHO efficacy criteria	–	Significantly lower (p<0.05)	–	Significantly lower (p<0.05)	–	Upper 95% CI <1.43
	Conclusion	–	Superior	–	Inferior	–	Not non-inferior

Table S2: Supplementary cone bioassay results with the susceptible *Anopheles gambiae sensu stricto* Kisumu strain. A total of 40–60 mosquitoes were exposed to each of the five net pieces per treatment arm for 3 mins in ten batches of 4–6.

Net type	Net status	N	N KD	% KD	95% CIs	N dead 24 h	% dead 24 h	N dead 48 h	% dead 48 h	N dead 72 h	% dead 72 h	95% CIs
Control	–	106	0	0	0-5	0	0	0	0	0	0	0-5.0
PermaNet 2.0	Unwashed before trial	55	55	100	95.0-100	53	96.4	55	100	55	100	95.0-100
	Washed 20x before trial	51	39	76.5	64.9-88.1	13	25.5	14	27.5	19	37.3	24.0-50.6
	Unwashed after trial	49	41	83.7	73.4-94.0	41	83.7	41	83.7	42	85.7	75.9-95.5
	Washed 20x after trial	49	43	87.8	78.6-97.0	33	67.3	35	71.4	36	73.5	61.1-85.9
PermaNet 3.0 (sides)	Unwashed before trial	42	39	92.9	85.1-100	38	90.5	38	90.5	39	92.9	85.1-100
	Washed 20x before trial	42	39	92.9	85.1-100	21	50.0	24	57.1	26	61.9	47.2-76.6
	Unwashed after trial	38	36	94.7	87.6-100	35	92.1	35	92.1	36	94.7	87.6-100
	Washed 20x after trial	45	38	84.4	73.8-95.0	40	88.9	42	93.3	43	95.6	89.6-100
PermaNet 3.0 (roof)	Unwashed before trial	31	27	87.1	75.3-98.9	31	100	31	100	31	100	95.0-100
	Washed 20x before trial	30	30	100	95.0-100	30	100	30	100	30	100	95.0-100
	Unwashed after trial	28	27	96.4	89.5-100	28	100	28	100	28	100	95.0-100
	Washed 20x after trial	31	30	96.8	90.6-100	31	100	31	100	31	100	95.0-100
Interceptor G2	Unwashed before trial	47	36	76.6	64.5-88.7	6	12.8	8	17.0	8	17.0	6.3-27.7
	Washed 20x before trial	50	17	34	20.9-47.1	4	8.0	4	8.0	7	14.0	4.4-23.6
	Unwashed after trial	49	32	65.3	52.0-78.6	20	40.8	21	42.9	22	44.9	31.0-58.8
	Washed 20x after trial	52	34	65.4	52.5-78.3	13	25.0	17	32.7	17	32.7	20.0-45.5
PermaNet Dual	Unwashed before trial	50	45	90	81.7-98.3	22	44.0	22	44.0	23	46.0	32.2-59.8
	Washed 20x before trial	51	27	52.9	39.2-66.6	8	15.7	10	19.6	13	25.5	13.5-37.5
	Unwashed after trial	52	37	71.2	58.9-83.5	24	46.2	24	46.2	26	50.0	36.4-63.6
	Washed 20x after trial	52	32	61.5	48.3-74.7	21	40.4	26	50.0	29	55.8	42.3-69.3

Table S3: Summary tunnel test results with the pyrethroid-resistant *Anopheles gambiae sensu lato* Covè strain. A total of 160–240 mosquitoes were exposed overnight to each of two randomly selected net pieces per treatment arm in one replicate tunnel test.

Treatment	Wash status	N exposed	Total Fed	N dead imm	N dead 24 h	N dead 48 h	N dead 72 h	N pass	% Imm Mort	% 24 h mort	% 48 h mort	% 72 h mort	95% CI	% Pass	95% CI	% Bfd	95% CI
Control	N/A	411	299	9	0	3	8	191	2.2	2.2	2.9	4.1	2.2-6.1	46.5	41.7-51.3	72.8	68.5-77.1
PermaNet 2.0	Unwashed before trial	218	44	29	21	38	75	73	13.3	22.9	30.7	47.7	41.1-54.3	33.5	27.2-39.8	20.2	14.9-25.5
	Washed 20 x before trial	198	69	35	17	30	51	65	17.7	26.3	32.8	43.4	36.5-50.3	32.8	26.3-39.4	34.9	28.2-41.5
	Unwashed after trial	211	29	78	25	39	52	70	37.0	48.8	55.5	61.6	55.1-68.2	33.2	26.8-39.5	13.7	9.1-18.4
	Washed 20x after trial	211	55	81	45	53	63	99	38.4	59.7	63.5	68.3	62.0-74.5	46.9	40.2-53.7	26.1	20.2-32.0
Interceptor G2	Unwashed before trial	202	31	187	13	13	13	42	92.6	99.0	99.0	99.0	97.6-100	20.8	15.2-26.4	15.4	10.4-20.3
	Washed 20 x before trial	235	46	212	15	17	18	57	90.2	96.6	97.5	97.9	96.0-99.7	24.3	18.8-29.7	19.6	14.5-24.6
	Unwashed after trial	231	23	223	7	7	7	74	96.5	99.6	99.6	99.6	98.7-100	32.0	26.0-38.1	10.0	6.1-13.8
	Washed 20x after trial	224	40	220	2	2	2	66	98.2	99.1	99.1	99.1	97.9-100	29.5	23.5-35.4	17.9	12.8-22.9
PermaNet Dual	Unwashed before trial	216	19	188	23	23	23	66	87.0	97.7	97.7	97.7	95.7-99.7	30.6	24.4-36.7	8.8	5.0-12.6
	Washed 20 x before trial	224	15	215	8	8	8	53	96.0	99.6	99.6	99.6	98.7-100	23.7	18.1-29.2	6.7	3.4-10.0
	Unwashed after trial	229	11	227	2	2	2	47	99.1	100	100	100	–	20.5	15.3-25.8	4.8	2.0-7.56
	Washed 20x after trial	238	17	229	6	6	6	69	96.2	98.7	98.7	98.7	97.3-100	29.0	23.2-34.8	7.1	3.9-10.4