

WHO International Scheme to Evaluate Household Water Treatment Technologies

JAMEBI Solar Water Pasteurizer

Product evaluation report

WHO performance classification	Comprehensive protection Two-star (★ ★)
Manufacturer	Relevant Projects Ltd 15 King Street Chester CH1 2AH United Kingdom www.jamebi.com
Evaluation procedure	Abbreviated laboratory testing
WHO report issue date	Round II, 2018
WHO reference number	20/07/2015-R2-16

Summary of evaluation

This report summarizes the results of laboratory testing of a solar pasteurization device known by the tradename 'JAMEBI' Solar Water Pasteurizer under Round II of the World Health Organization (WHO) International Scheme to Evaluate Household Water Treatment Technologies (the Scheme). Testing followed the requirements of the WHO protocol for solar (UV and heat) technologies. Testing investigated the ability of the device to inactivate bacteria and viruses. Reduction of protozoa was assigned based on the mean bacterial reduction achieved. Based on the evaluation results, the JAMEBI Solar Water Pasteurizer meets WHO performance criteria for bacteria, viruses and protozoa and is classified as providing two-star (★ ★) *Comprehensive protection*.

Background

Evaluation under the Scheme is based on performance criteria set out in *Evaluating Household Water Treatment Options: Health-based targets and microbiological performance specifications* (WHO, 2011). The criteria were determined by applying quantitative microbial risk assessment (QMRA) methods outlined in the WHO *Guidelines for Drinking-water Quality* (2017) and set \log_{10} reduction targets against bacteria, viruses and protozoa in Table 1.

Table 1. WHO performance criteria for household water treatment technologies

Performance classification	Bacteria (\log_{10} reduction required)	Viruses (\log_{10} reduction required)	Protozoa (\log_{10} reduction required)	Interpretation (with correct and consistent use)
★★★	≥ 4	≥ 5	≥ 4	Comprehensive protection
★★	≥ 2	≥ 3	≥ 2	
★	Meets at least 2-star (★★) criteria for two classes of pathogens			Targeted protection
—	Fails to meet criteria for 1-star (★)			Little or no protection

Product description

The JAMEBI Solar Water Pasteurizer is a flow-through pasteurization device. It comprises a solar thermal panel, a thermostatic control valve and an external heat exchanger. Water is heated to 75 °C in the heat exchanger's outer pipe. The water then flows into the solar thermal panel, where it is pasteurized at approximately 80 °C for four minutes. The pasteurized water then flows into the inner pipe of the heat exchanger, where it is cooled before release. The full description, illustrations and use instructions can be found at: www.jamebi.com.

Test methods

Product-specific test plan: A product-specific test plan was developed based on the manufacturer's instructions for use; the Harmonized Testing Protocol: Technology Non-Specific V 2.0 (WHO, 2018a); and the tSolar (UV and heat) Disinfection Technology Protocol V 2.0 (WHO, 2018b). Testing was conducted at a WHO-designated laboratory, KWR Watercycle Research Institute, in the Netherlands.

Test organisms: Evaluation of the JAMEBI Solar Water Pasteurizer investigated its performance in reducing the quantity of bacteria and viruses. The test organisms were *Escherichia coli* (*E. coli*) and bacteriophages MS2 and phiX174. Based on the available evidence on pasteurization on the reduction of protozoa, testing against this microbial group was not conducted (WHO, 2018a). The protozoan reduction is assigned based on the mean bacterial reduction observed.

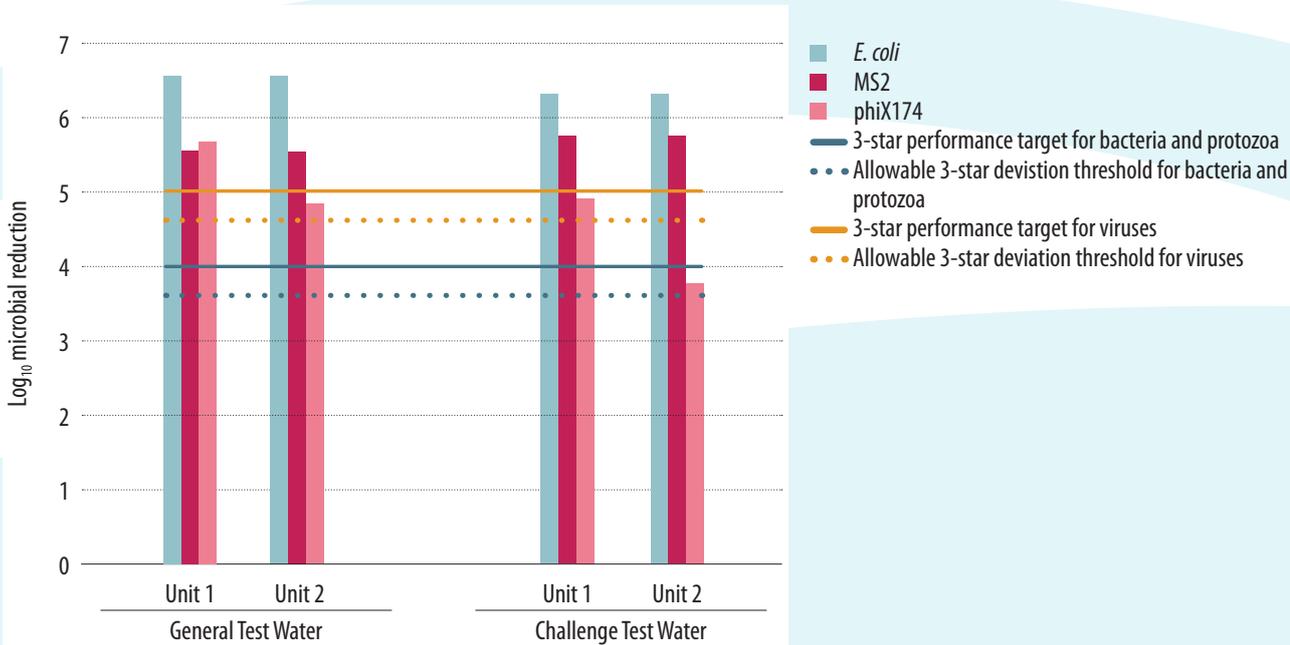
Test waters: The device was tested in two simulated natural waters: General Test Water (GTW), simulating high quality groundwater, and Challenge Test Water (CTW), simulating surface water. Details on the physicochemical characteristics of the test waters are provided in the Solar (UV and heat) Disinfection Technology Protocol V 2.0.

Test set up: Two new production units were used for the test. The units were set-up under natural sunlight and the unit flow rate, exposure time, weather conditions and solar irradiance were measured. The units were operated according to the manufacturer's use instructions. Pretreatment and posttreatment water grab samples were analysed using methods identified in the product-specific test plan. Testing was conducted over six days (in GTW on Days 1-3 and in CTW on Days 3-6), resulting in a total of 12 sample points for each organism (i.e. 3 days × 2 test waters × 2 test units).

Results

Fig. 1 presents the results of the bacterial and viral testing for the two units in GTW and CTW. All test water characteristics were within specifications.

Fig. 1 Performance across test units¹



The JAMEBI Solar Water Pasteurizer achieved mean \log_{10} reductions of ≥ 6.4 for *E. coli*, ≥ 5.6 for MS2 and U5.1 for phiX174. Performance against viruses across the two test units was somewhat variable, and Unit 1 consistently achieved higher viral reductions than Unit 2 in both test waters.

One third of the Unit 2 sample points for phiX174 were below the maximum allowable deviation threshold of 4.6 \log_{10} for viruses.

Interpretation and application of results

Performance is classified in three ascending tiers: ★ (one-star); ★★ (two-star); and ★★★ (three-star), as shown in the table outlining performance criteria. Both three- and two-star products provide *Comprehensive protection* against all three microbial groups. One-star products meet performance targets for only two of the three microbial groups, providing *Targeted protection*.

Each production unit should consistently meet or exceed the performance target for each microbial group in both test waters (GTW and CTW). A maximum deviation of 0.2 \log_{10} is acceptable for 25% of sample points at the two-star performance tier and of 0.4 \log_{10} at the three-star performance tier². This means that for classification as a three-star product, up to three of the 12 sample points can achieve a reduction of 3.6 \log_{10} for bacteria or protozoan cysts (instead of 4 \log_{10}) or of 4.6 \log_{10} for viruses (instead of 5 \log_{10}). Each phage is treated separately for evaluating acceptable allowance; the overall claim for viruses is based on the lower performing phage.

¹ The maximum reduction that can be demonstrated is limited by the pretreatment challenge concentration delivered. For each organism tested, the pretreatment concentration must be sufficient to allow for the demonstration of the performance targets in the table showing the performance criteria. Due to the complexity of using viable organisms, there may be variation in these pretreatment concentrations above what is sufficient, which may lead to demonstrated reductions reported that far exceed the performance targets. However, the emphasis is on whether the performance target has been met and not the extent by which the target was exceeded.

² These cut-off values were determined using QMRA modelling and selecting ranges that still resulted in appreciable health gains within a specific performance tier.

Performance classification

The JAMEBI Solar Water Pasteurizer met the ★★★ (three-star) performance target for bacteria. Protozoan reduction was assigned as 6.4 log₁₀ based on the mean bacterial reduction observed. Performance against viruses is based on the lower performing phage. The JAMEBI did not meet the ★★★ (three-star) viral reduction target of 5 log₁₀ for phiX174, but exceeded the★★ (two-star) reduction target of 3 log₁₀. As such, the JAMEBI Solar Water Pasteurizer is classified as providing *Comprehensive protection* (★★).

Considerations for product selection

	Microbial conditions	Effective against bacteria, viruses and protozoa; can be used under all microbial water quality conditions
	Physicochemical water characteristics	Pre-treat water through e.g. filtration / settling to reduce turbidity
	Environmental conditions	Relies on solar / thermal energy; most appropriate for sunny climates
	Product information and labelling	Check that product is appropriately labelled and has clear instructions for use

References

WHO (2011). Evaluating household water treatment options: health-based targets and microbiological performance specifications. Geneva: World Health Organization (http://www.who.int/water_sanitation_health/publications/household_water/en/).

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WHO (2018a). Harmonized Testing Protocol: Technology non-specific version 2.0. Geneva: World Health Organization (http://www.who.int/water_sanitation_health/water-quality/household/household-water-treatment-scheme-resources/en/).

WHO (2018b). Solar (UV and heat) Disinfection Technology Protocol version 2.0. Geneva: World Health Organization (http://www.who.int/water_sanitation_health/water-quality/household/household-water-treatment-scheme-resources/en/).

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