Summary of evaluation

This report summarizes the evaluation results of a flocculant–disinfectant known by the tradename ‘Bishan Gari Water Purifier’, under Round III of the World Health Organization (WHO) International Scheme to Evaluate Household Water Treatment Technologies (the Scheme). Evaluation of the Bishan Gari Water Purifier followed the requirements of the WHO protocols for coagulant–flocculant and chlorine disinfection technologies, and investigated the ability of the product to reduce bacteria, viruses and protozoa.

Based on the evaluation results, Bishan Gari Water Purifier meets WHO performance criteria and is classified as providing one-star (★) targeted protection against bacteria and viruses only.
1. 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 the quantitative microbial risk assessment (QMRA) methods outlined in the Guidelines for Drinking-water Quality (WHO, 2017) and set log_{10} reduction targets against bacteria, viruses and protozoa, as shown in Table 1.

Table 1. WHO performance criteria for household water treatment technologies

<table>
<thead>
<tr>
<th>Performance classification</th>
<th>Bacteria (log_{10} reduction required)</th>
<th>Viruses (log_{10} reduction required)</th>
<th>Protozoa (log_{10} reduction required)</th>
<th>Interpretation (with correct and consistent use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌟🌟🌟</td>
<td>≥ 4</td>
<td>≥ 5</td>
<td>≥ 4</td>
<td>Comprehensive protection</td>
</tr>
<tr>
<td>🌟🌟</td>
<td>≥ 2</td>
<td>≥ 3</td>
<td>≥ 2</td>
<td>Meets at least 2-star (🌟🌟) criteria for two classes of pathogens Targeted protection</td>
</tr>
<tr>
<td>🌟</td>
<td></td>
<td></td>
<td></td>
<td>Fails to meet criteria for 1-star (🌟) Little or no protection</td>
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<tr>
<td>–</td>
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<td></td>
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</tbody>
</table>

Product description

Bishan Gari Water Purifier is a combined flocculant-disinfectant powder containing aluminium sulphate, ferric sulfate and calcium hypochlorite. The aluminium sulfate and ferric sulfate act as coagulating and flocculating agents that aggregate particulates and some of the microorganisms suspended in water. The resulting flocules sediment at the bottom of the water vessel, and the calcium hypochlorite acts as a disinfectant.

The product is available as 2.1 g and 2.2 g sachets that can each treat 20 L of water.

The full product description, illustrations and use instructions can be found on the manufacturer’s website: www.bgpgroup.com.

2. Evaluation approach

Product-specific test plan: A product-specific test plan was developed based on the manufacturer’s instructions for use; the Scheme Harmonized Testing Protocol: Technology Non-Specific V 3.0 (WHO, 2019); the Chemical Coagulation and Flocculation Technology Testing Protocol V 3.0 (WHO, 2020); and the Chlorine Disinfection Technology Testing Protocol V 3.2 (WHO, 2020). Testing was conducted at a WHO-designated laboratory, NSF International, in the United States.

Test organisms: Evaluation of Bishan Gari Water Purifier investigated its performance in removing bacteria, viruses and protozoa. The test organisms were Escherichia coli (E. coli), representing bacteria; coliphages MS2 and phiX174, representing viruses; and Cryptosporidium parvum (C. parvum), representing protozoa.

Test waters: The product was tested in two waters: general test water (GTW), simulating high quality groundwater, and challenge test water (CTW), simulating surface water. Refer to the Chemical Coagulation and Flocculation Technology Testing Protocol V 3.0 (WHO, 2020); and the Chlorine Disinfection Technology Testing Protocol V 3.2 (WHO, 2020) for details on physicochemical characteristics of the test waters.

Test procedure: The manufacturer provided sample sachets from two production lots of the Bishan Gari Water Purifier for the test. The samples were applied to the test waters according to the manufacturer’s use instructions. One sachet of the product was added to each 20 L batch of GTW and CTW. Immediately after adding the product, the waters were stirred rapidly for 2 minutes and then slowly for 5 minutes. After the test solutions were allowed to sit for 30 minutes, they were strained through new cotton T-shirts to remove the floc. Three sachets from each production lot were each tested in GTW and CTW, resulting in a total of
12 sample points for each organism (i.e. 2 lots x 2 test waters x 3 sachets). Pretreatment and posttreatment water grab samples were analysed using the methods identified in the product-specific test plan.

Posttreatment free residual and total chlorine samples were collected and analysed. According to the Guidelines for Drinking-water Quality (WHO, 2017), the concentrations of chlorine should not exceed the health-based guideline value of 5 mg/L.

3. Results

Fig. 1 presents the results of the microbial testing in GTW and CTW. All test water characteristics were within specifications.

Fig. 1. Performance across test organisms

Bishan Gari Water Purifier achieved mean log_{10} reductions greater than 8.21 for *E. coli*; greater than 5.42 for MS2; greater than 5.16 for phiX174; and 1.64 for *C. parvum*.

Posttreatment mean concentrations of free residual and total chlorine in GTW were 1.6 and 1.8 mg/L, respectively, and were 0.6 and 0.8 mg/L in CTW.

4. Interpretation and application of results

As shown in Table 1, performance is classified in three ascending tiers: ★ (one-star); ★★ (two-star); and ★★★ (three-star). 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 0.4 log_{10} at the three-star performance tier. This means that for classification as a

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1. The maximum microbial 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 shown in Table 1. Due to the complexity of using viable organisms, these pretreatment concentrations may be above what is sufficient, which may lead to demonstrated reductions 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 result in appreciable health gains within a specific performance tier.
two-star product, up to three of the 12 sample points can achieve a minimum reduction of $1.8 \log_{10}$ for bacteria or protozoan cysts (instead of $2 \log_{10}$) or $2.8 \log_{10}$ for viruses (instead of $3 \log_{10}$). Each phage is treated separately for evaluating acceptable allowance, and the overall claim for viruses is based on the lower performing phage.

**Performance classification**

Bishan Gari Water Purifier fully met performance targets for bacteria and viruses. The minimum performance target for protozoa was not met. As such, the Bishan Gari Water Purifier is classified as providing one-star (★) targeted protection against bacteria and viruses only.

**Considerations for product selection**

<table>
<thead>
<tr>
<th>Microbial conditions</th>
<th>Use where contaminant of concern is known to be bacterial/viral microbes</th>
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<tbody>
<tr>
<td>Physico-chemical water characteristics</td>
<td>Can be used to treat turbid water</td>
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<tr>
<td>Product information and labelling</td>
<td>Check that the product is appropriately labelled and has clear instructions for use</td>
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</tbody>
</table>

**References**


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