EXECUTIVE SUMMARY

Jug water filters are popular, and undoubtedly can improve certain aspects of water quality. However, there is also the possibility that under certain circumstances they could lead to deterioration in quality. For example:

- Growth of bacteria in the filter cartridge could lead to elevated levels of Heterotrophic Plate Count (HPC) bacteria in the filtrate. Excessive growth could lead to an impairment of flavour and odour.

- Filters that incorporate silver to control the growth of bacteria could leach excessive concentrations into the filtered water.

- Partial softening of the water could lead to elevated leaching of metals from kitchen appliances and utensils such as kettles and saucepans.

Misuse or abuse by the consumer could exacerbate any problems due to bacterial growth. For example failure to change the filter cartridge at the recommended intervals could lead to a build up of bacteria. If the filter cartridge was contaminated with pathogenic bacteria, as a result of poor personal hygiene or contamination in the kitchen, the filter could become colonised leading to the presence of pathogens in the filtered water.

This laboratory study was undertaken to examine possible adverse effects of jug filters on water quality. The tests examined the effects of the devices both when operated according to the instructions for use and when operated so as to simulate misuse.

The tests were run with two test waters: “Water X”, a low-nutrient groundwater, and “Water Y”, a high nutrient surface water. A soft water (“Water Z”) was used in tests on metals leaching. Tests were undertaken using three popular brands of jug filter over an eight-week period (twice the manufacturers’ recommended lifetime). Five litres of water were filtered on each test day (Monday to Friday) and samples were taken when the following cumulative volumes had been filtered: 5, 10, 15, 25, 50, 75, 100, 150 and 200 litres. In addition, each Monday following stagnation over the weekend, the first litre filtered was sampled followed by a further sample after a total of two litres of filtrate had been discarded, as per the manufacturers’ instructions. Tests were also run on another filter system over its claimed lifetime of 20 weeks, following a similar protocol. Additional tests were undertaken to examine the effects of bacterial contamination of filters, storage of filtered water, prolonged non-use of filters and metals leaching from kitchenware.

As expected HPC levels were greater in Water Y than in Water X. The HPC levels in the feed waters were variable over the period of testing, as is expected with waters taken from supply. It should be noted that increases in HPC levels are not of themselves indicative of potential adverse health effects.

Both 22 °C and 37 °C HPC levels tended to be higher in the filtrates than in the feed water. The 22 °C HPC levels with Water Y tended to increase over the period of testing

for “regular” samples whereas in the Monday morning samples the levels peaked around the middle of the testing period. These results, obtained over a prolonged period of testing are reassuring in that there was no evidence of an “explosion” in HPC levels. In general the results are in line with expectations, with growth of HPC bacteria being greater with the high nutrient Water Y.

With the Monday morning samples, the HPC levels in the third litre filtered were generally (but not always) lower than in the first litre. Thus the manufacturers’ recommendations to discard filtered water in order to flush the cartridge are partially effective. However, even after discarding two litres of filtrate the 22 °C HPC levels in the high nutrient water tended to be higher than those for “normal” samples at an equivalent stage of filter life.

Silver leached from three of the filters tested. There is a lack of toxicological data on long-term human exposure to silver in drinking water to determine whether the concentrations found are of concern to health. The concentration of silver leached fell over the period of testing.

There was no evidence that the filters caused deterioration in odour or flavour; some panellists detected odour and flavour in some filtered water samples but there was no clear pattern or consistency when all of the panellists’ results were considered. There was no deterioration in odour or flavour even for samples taken well past the recommended lifetime for the filter cartridges. These results indicate that the odour or flavour of the filtered water would not indicate to consumers that the cartridge life had been exceeded.

Tests were run in which the filters were deliberately challenged with *E. coli* and *Salmonella* to simulate contamination of the filter. It was found that these organisms were only present – if at all – in the first filtrate following inoculation. Thereafter these bacteria were not detected in any filtrate, or in the filter media at the end of the experiment. These results are reassuring in that they indicate that pathogenic bacteria will not survive in the filtered water or in the filter media.

Storage of filtered water had little effect on HPC levels in the low-nutrient Water X. With the high nutrient Water Y, HPC levels tended to increase with storage of the filtered water; storage of the unfiltered water also resulted in a smaller increase in HPC.

Allowing filters to stagnate for seven days (prolonged non-use) with Water X had little effect on HPC levels in the filtrates. With Water Y the 22 °C HPC levels in the filtrates increased when the filters were stored, and the effects were greater with storage at 20 °C than at 4 °C. This demonstrates that it is advisable to store filter cartridges in a refrigerator during periods of prolonged non-use.

Overall there was no evidence that jug water filter systems have adverse effects on microbial water quality, even when tested under conditions simulating abuse and contamination.

Metals leaching tests were run in which jug-filtered water was boiled in kettles and saucepans. These tests showed substantial leaching of nickel into filtered hard Water X and soft Water Z when boiled in kettles with exposed nickel-plated elements. There was

little leaching of the other metals that were tested for (chromium and iron) when filtered water was boiled in kettles with flat bed stainless steel elements and stainless steel and saucepans. High nickel concentrations were also found when unfiltered water samples were boiled in kettles with exposed nickel-plated elements.

Additional tests were undertaken using hard Water X with eight models of kettle with exposed heating elements; six of these had nickel-plated elements and the other two had non-plated stainless steel elements. The kettles with nickel-plated elements leached substantial quantities of nickel. These tests were run over a four-week period, over which time the nickel levels gradually fell. At the start of the test, with new filter cartridges, leaching of nickel was higher with jug-filtered water than untreated Water X. As the jug filters became exhausted the nickel concentrations fell to levels at or below those of untreated Water X. The increased leaching observed with new filter cartridges was associated with the reduced pH and alkalinity of the water. Nickel did not leach from kettles with stainless steel elements. A small-scale survey of households also showed nickel leaching from certain kettles, higher nickel levels being associated with boiling water filtered through new filter cartridges.