WATER SANITATION HYGIENE AND HEALTH STUDIES PROJECT
AGA KHAN HEALTH SERVICE, NORTHERN AREAS AND CHITRAL

THE MUSAFFA WATER DECONTAMINATION BAG

an assessment of its efficacy for household water-treatment in North Pakistan

by

Manzoor Hussain, Haider Raza, Khalil Ahmed
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ASSESSMENT OF THE EFFICACY OF THE MUSAFFA WATER DECONTAMINATION BAG

I. INTRODUCTION

The Musaffa water decontamination bag is manufactured by the private sector first of all by the STADEC then the U.S. Health Care. It has the seal of approval from the Pakistan Council of Scientific and Industrial Research (PCSIR). In the Northern Areas, the Musaffa bag was promoted by the Aga Khan Housing Board (AKHB) in mid 1980's under the Living Conditions Improvement Programme (LCIP). According to the AKHB sources, about a thousand Musaffa bags were made available at a subsidized cost to the people of Gilgit, Ghizer and Chitral districts. Since the end of the LCIP in 1989, promotion of the Musaffa bag has received less attention. It has been proposed, however, by AKHB Norther Region that a follow-up campaign is desired.

From the recent studies of the water quality conditions in more than 100 villages in the Northern Areas and Chitral by the Water, Sanitation, Hygiene, and Health Studies Project (WSHHSP) it was found out that the majority of the common sources and systems in the area are faecally contaminated. According to the Government statistics 30 percent of the population are estimated to have piped systems. The vast majority of the remaining population rely on the traditional means of open channels and water pits. Water transmitted epidemics like cholera have been experienced more frequently in the Northern Areas in the recent years. Under these circumstances it is important that appropriate methods of household water treatment are identified, tested and if necessary for use by the majority of the rural population. One such technology already introduced to the area in a small way is the Musaffa bag.

Since no detailed data existed about the efficacy of the Musaffa bag under different operating conditions it was proposed that the WSHHSP should carry out a careful assessment. This would aim to determine the potential role of the Musaffa bag as a safe household drinking water treatment technology.

The experiments on the Musaffa bag were undertaken by the WSHHSP's microbiologists in the Gilgit laboratory. The experiments were initiated in February 1994 and were continued for a period of one year.

II. MANUFACTURER'S GUIDELINES

The Musaffa bag is sold in a paper box packing. It includes a page of user instructions printed in both Urdu and English. In the early production (late 1980s) a plastic clip was provided with the bag. It was instructed that the Musaffa bag should be used in a water-cooler with the bag fitted against the tap intlet by means of the plastic clip. It was claimed that the Musaffa bag can purify water of unspecified quality within five minutes and that the bag had a useful life of six months when used in a 12 liter water cooler.

The current presentation of Musaffa no longer includes the clip. There are no specific instructions for the position of the bag in the container or for the withdrawal of water. It suggests that the bag can be used in almost any container including a clay-pot (Matka), water-cooler, thermos flask or a small water tank. It has been claimed in the promotion literature that in any of the above mentioned containers the water will be purified within three minutes.

The bag is available in two sizes i.e. 1/4 Kg and 1 Kg. The smaller bag has been recommended for use by an average family of six persons for one month whereas the 1 Kg bag is claimed to last the family for six months. In a promotion leaflet it specifies that the 1 Kg bag is sufficient for treating 2500 liters of water.

III. DESIGN OF THE EXPERIMENTS

While designing the experimental procedure it was decided that the research should take into account the real life conditions in Project area. In order to make the research practical and usefully applicable the following factors were considered:

1. The WHO Guideline for drinking-water quality (1993)[1] recommends zero *Escherichia coli (E.coli)* per 100 ml in all samples of drinking water. This same guideline value has been considered as a requirement for a treated sample through the Musaffa bag. In the following sections of this report terms such as 'total decontamination' and 'complete decontamination/disinfection' refer to water samples with zero *E.coli* per 100 ml.

2. According to the water quality testing work of the Project carried out by the WSHHSP in 1993, the majority of the commonly used rural drinking water sources contain *E.coli* levels of typically 200 to 400 per 100 ml. It was therefore, decided that the test waters should have a contamination level in the above range.

3. More than 35 percent of the water sources in the area become turbid in the summer months. In this same period the faecal pollution of the drinking water sources is at its highest and so is diarrhoeal disease. Testing the efficacy of Musaffa bag under these conditions was also planned.

4. From the KAP-survey and the Domestic Observation Study of the WSHHSP it appeared that it is common amoung the rural households of having plastic water coolers. However, it appears that use of these coolers is generally limited to special occasions and seasons. It was observed that water is commonly stored in different pots and containers which do not have a tap to extract water. The normal way of withdrawing water is from the container's top either using a cup or a ladle, or by tilting the container to one side. The tests were therefore, conducted under both conditions i.e. by placing the Musaffa bag against the cooler's tap, and by placing it on the bottom and extracting water from the

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[1] World Health Organization, Guidelines for drinking-water quality, Second Edition, Volume 1, Recommendations WHO Geneva, 1993. pp 24-26 and 173

cooler's top. This is also in compliance with the user-instructions for the currently marketed Musaffa bag which highlights the use of the bag in a Matka.

5. The average family size in the Northern Areas is estimated to be 8 members. For a family of this size it is important that there is an adequate rate of flow through the cooler tap to satisfy the needs of each member in a reasonable time. Flow rate measurement was therefore included in the tests.

6. For an average family of 8, it was estimated that 12 liters of water will be consumed for drinking purposes daily. This figure also matches the manufacturer's recommended quantity which can be treated safely with a 1 Kg bag i.e. 2500 litres.

Having decided to investigate the efficacy of Musaffa bag under different operating conditions, the following regimens were chosen:

1. Using non-turbid water, to assess the bactericidal efficacy of the bag fitted over the tap with the help of its clip when it is new, after one month, two months, three months, six months, eight months and one year old, with the bag washed everyday, every three days, once a week, once a month and not at all.

2. Same as number 1 using turbid water.

3. Using non-turbid water, to assess the bactericidal efficacy of the bag placed on the bottom of the cooler when it is new, one month old, two months old, three months old, six months old, eight months old and a year old, with the bags washed everyday, every three days, once a week, once a month and not at all.

4. Same as number 3 using turbid water.

5. For non-turbid water, and with the bag placed against the cooler tap inlet, to determine the water flow rate through the cooler tap, when the bag is new, after being used for four months, nine months and one year, with the bag washed everyday, every three days, once a week, once a month and not at all, with the cooler completely full, 3/4 full, 1/2 full and 1/4 full.

6. Same as number 5 using turbid water.

7. To determine the weight-loss, weighing the Musaffa bags after 6 month and 12 months of use.

IV. METHODOLOGY AND EQUIPMENT USED

For the micro-biological sampling of raw and treated waters, the membrane filtration method was employed. Through membrane filtration, the number of *E.coli* colonies were detected in the water samples. A duplicate sample was taken in each case, the result shows the average of the two duplicates. Flow-rate tests were conducted by using a stop watch and a 500 ml glass jar. The Musaffa bags for testing were provided by the AKHB's Northern Region.

In the first phase of experiments non-turbid (less than 5 TUs), contaminated water was used. Ten water coolers of 16 liter capacity (trademark 'Joy') were purchased from the local market for conducting these tests. In the first set of five coolers the bags were fitted against the intlet of the cooler's tap by means of the clip. Out of these five bags, four were washed with a different frequency i.e. every day, every third day, every week, every month, whereas the fifth bag was never washed. In the other set of the five coolers the bags were placed on the bottom of the coolers. (Figure 4.1 shows these two arrangements). Washing of the bags in the second set of coolers was conducted in the same way as for the first set.

Each cooler was filled and drained with 12 liters of water every day to simulate actual use in a family. A sample of the raw water was taken to check the (background) water-quality before performing the bacteriological tests on the treated water. For maintaining the desired range of contamination, a few drops of heavily contaminated water were added if necessary, and the level of the contamination was checked by undertaking another test. Water sampling of each of the ten coolers was conducted every month for the first four months and then at the end of six, eight and twelve months. A series of samples were taken at different intervals of time from each cooler on the specified sampling date. Sampling was started after five minutes of re-filling and was continued at the intervals 15 minutes, 30 minutes, 1 hour, 2 hour, 3 hour, 4 hour, 6 hour, and 8 hours. This allowed assessment of the efficiency of each bag in terms of the time taken for complete decontamination of the water in the cooler. Normally, sampling of one cooler was conducted in one day.

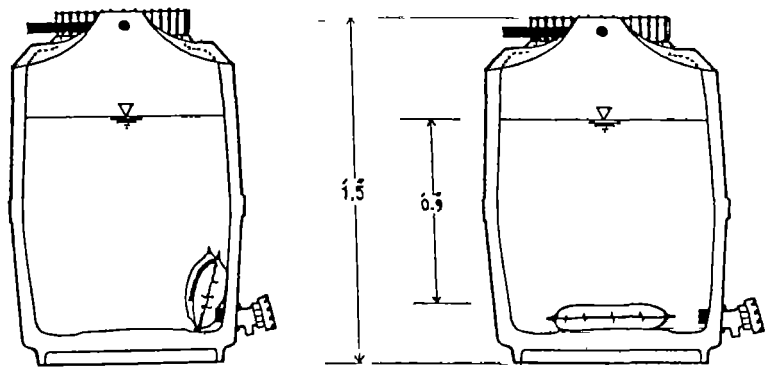


Figure 4.1 Diagram of a 16 liter capacity JOY water-cooler filled with 12 liters of water, (a) with the bag placed against the inlet of cooler's tap, (b) with the bag placed on the bottom of the cooler.

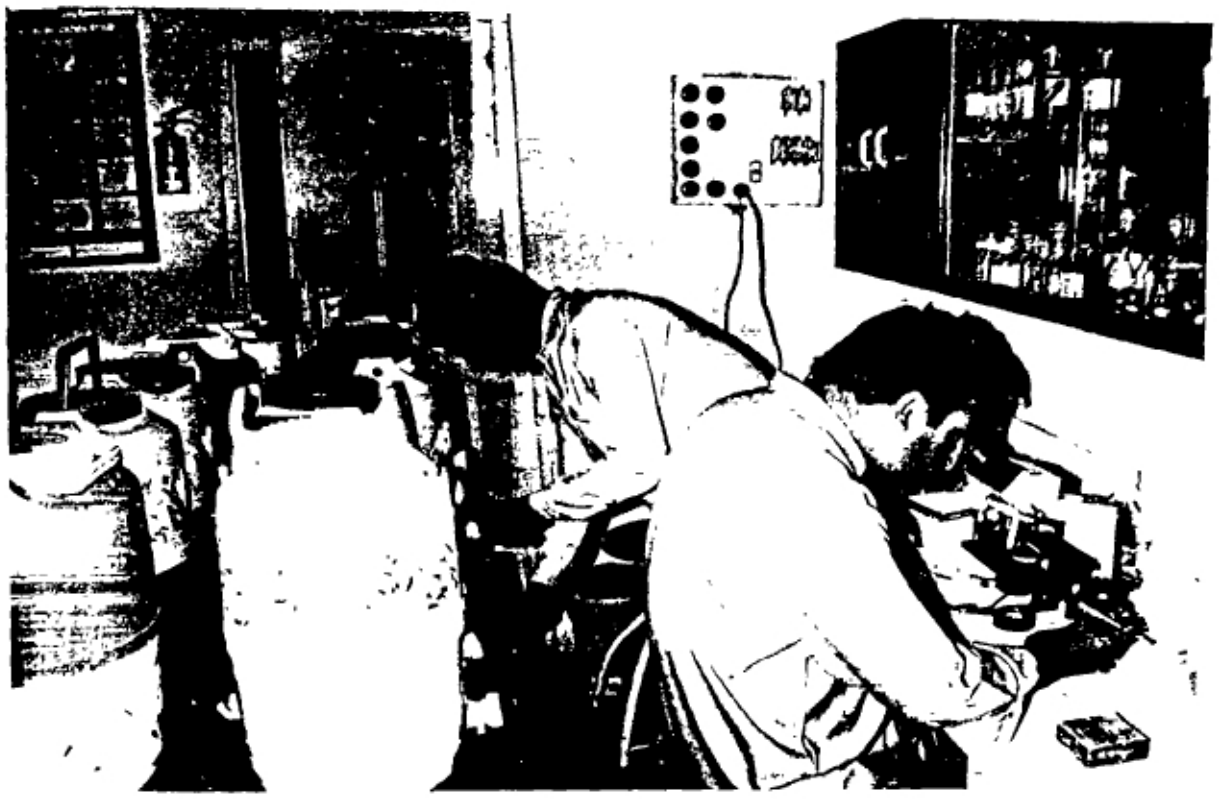


Figure 4.2 Microbiologists performing Musaffa experiments in the Gilgit laboratory.

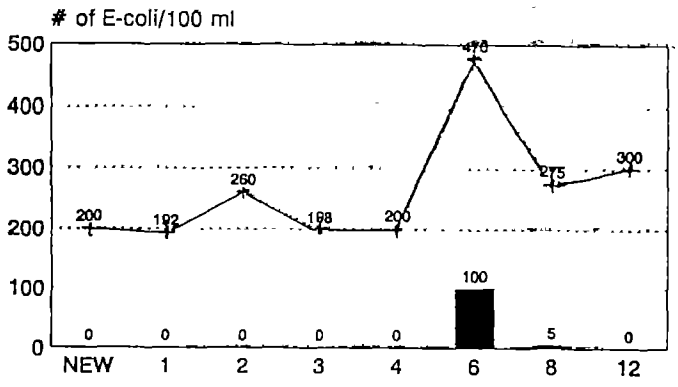
Phase two of the experiments using the turbid, contaminated water were conducted between June and August 1994. Turbidity levels of the test-waters were maintained in the range of 60 TUs to 1000 TUs. During the initial tests with the turbid water, some major limitations of the Musaffa bag were discovered therefore, a prolonged series of tests was not necessary.

V. RESULTS

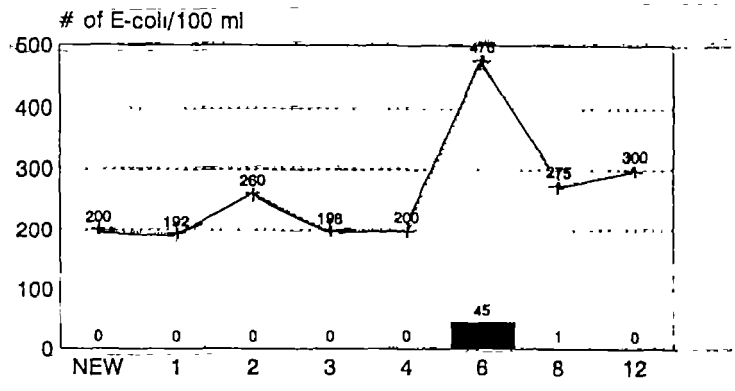
5.1 Clear, contaminated water (Phase I)

5.1.1 For the bags fitted against the cooler taps

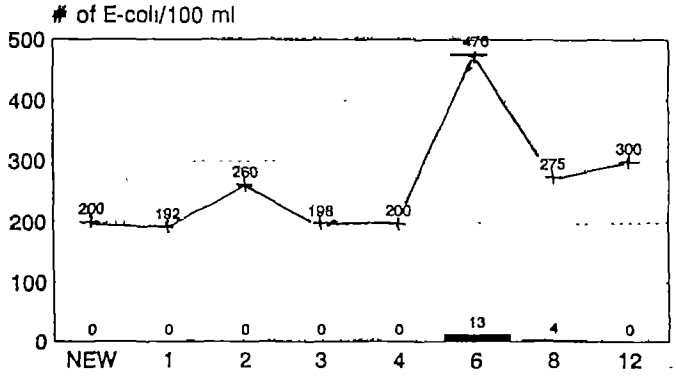
For the bags placed against the cooler taps (samples taken from the tap), the best bactericidal performance was shown by the bags which were less frequently washed. The best result was from the bag which was never washed. Results of this bag showed that for the initial four months, samples taken after five minutes of re-filling (contact time) were completely decontaminated (see Fig. 5.1a). The average background contamination level (BCL) for these four months raw-water samples (five samples including the sample when the bag was new) was 232 *E.coli*/100 ml. At the end of six months the same bag achieved complete decontamination only after 6 hours. In this case the BCL of the raw water was 476 *E.coli*/100 ml (see Fig. 5.1d).



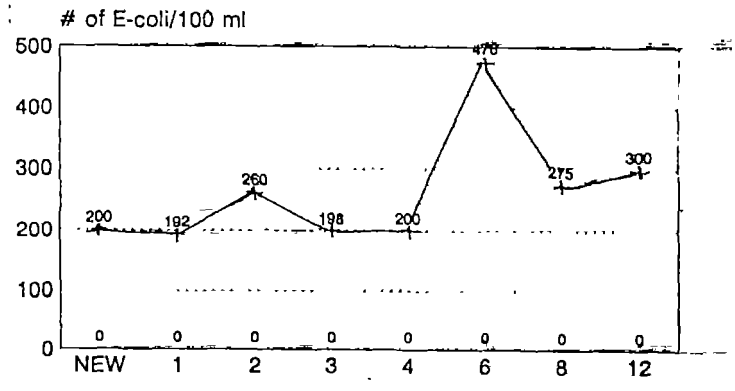
Age of the filter bag (months)
Samples taken after 5 minutes
(a)



Age of the filter bag (months)
Samples taken after 1 hour
(b)



Age of the filter bag (months)
Samples taken after 3 hours
(c)



Age of the filter bag (months)
Samples taken after 6 hours
(d)

Turbidity of raw water < 5 TUs
Position of the filter bag: Fitted over the tap

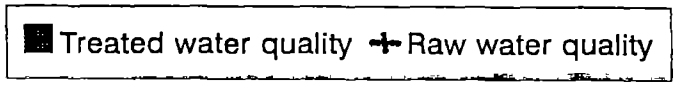


Fig. 5.1 Bactericidal efficacy of filter bag in cooler # 5 (never washed)

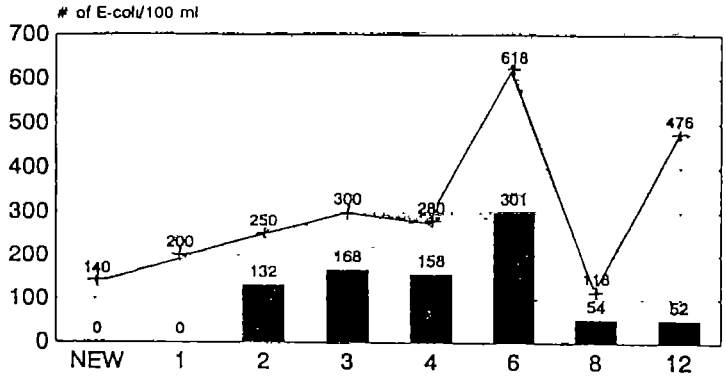
Results of the tests conducted for the bag washed once a month are similar to those for the bag that was never washed. Also in this case, complete decontamination was achieved within five minutes of contact time for the first four months, and then later after six hours (refer to Fig. 5.2). For both of the above cases, complete decontamination of the raw water was obtained for one year with a contact time of 6 hours. The average BCL of these 8 raw-water samples was 289 *E.coli*/100 ml.

In comparision, the bag that was washed daily, for a 5 minutes contact time, achieved complete decontamination for only one month. Results of the second month tests showed less than 50 percent decontamination for the same contact time for a moderate BCL of 250 *E.coli*/100 ml (see Fig. 5.3a). With a 6 hour contact time, complete decontamination with this bag was achieved only for the first three months (see Fig. 5.3d). As the washing frequency decreases the bags show a better performance.

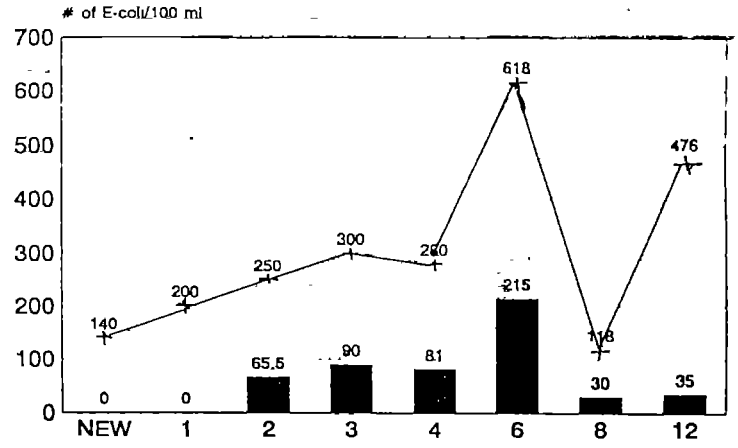
With the Musaffa bag fitted on the cooler's tap, flow rate is considerably diminished. Without a bag on the tap it took 5 sec, 6 sec, 7 sec and 10 sec to extract 250 ml (a normal glass of water) when the cooler was full, 3/4 full, 1/2 full and 1/4 full, respectively. Whereas, with a new bag against the tap it took 29 sec with full, 44 sec with 3/4 full, 54 sec with 1/2 full, and 93 sec with 1/4 full, for filling the same glass (see Table 5.1). Flow rate data at the end of four months show an improvement for the bags which were washed more frequently. For the bag washed every month and the one never washed, a very low flow rate was recorded at the end of 4 months use. This was apparently improved for the 8 and 12 month readings. No specific reasons for this improvement can be suggested except that the bags might have been fitted loosly over the taps while recording the flow-rates. Generally, water flow rate through the better performing bags diminished considerably with time.

Table 5.1 Time taken (in seconds) to fill a glass of water (250 ml) from the cooler tap with the bag fitted against the tap.

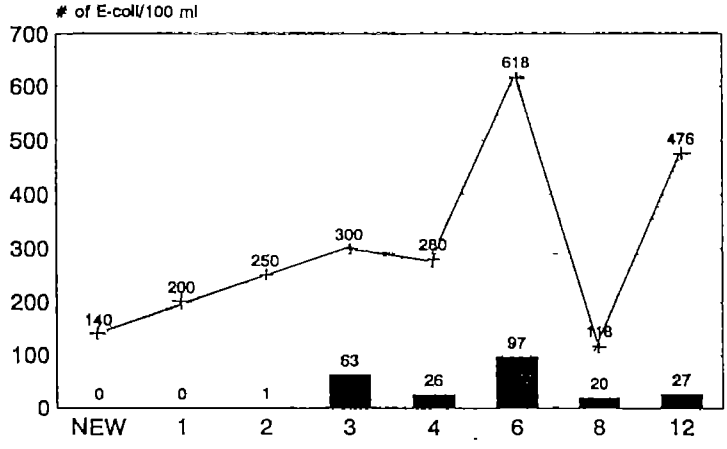
S.No	Status	Age	Quantity of water in the cooler			
			12 L	9 L	6 L	3 L
1	Without a bag		5	6	7	10
2	With a new bag.		29	44	54	93
3	Bag washed daily.	4 months	15	21	29	39
		8 months	25	33	42	60
		12 months	32	44	70	135
4	Bag washed every three days.	4 months	21	42	77	115
		8 months	29	48	57	78
		12 months	44	54	79	146
5	Bag washed every week.	4 months	26	52	127	249
		8 months	30	49	58	79
		12 months	45	54	77	160
6	Bag every month	4 months	52	86	136	302
		8 months	30	35	44	64
		12 months	41	50	76	165
7	Bag never washed.	4 months	62	105	112	398
		8 months	54	58	67	78
		12 months	58	76	102	251



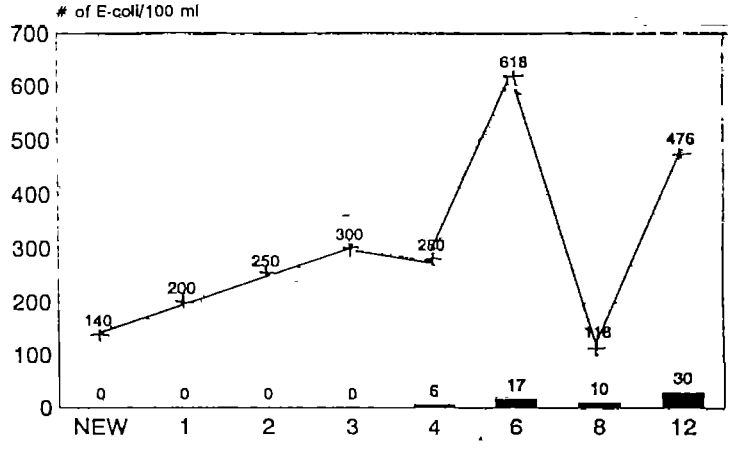
Age of the filter bag (months)
Samples taken after 5 minutes
(a)



Age of the filter bag (months)
Samples taken after 1 hour
(b)



Age of the filter bag (months)
Samples taken after 3 hours
(c)



Age of the filter bag (months)
Samples taken after 6 hours
(d)

Turbidity of raw water. < 5 TUs
Position of the filter bag. Fitted over the tap

Treated water quality — Raw water quality

Fig. 5.2 Bactericidal efficacy of filter bag in cooler # 4 (washed once a month).

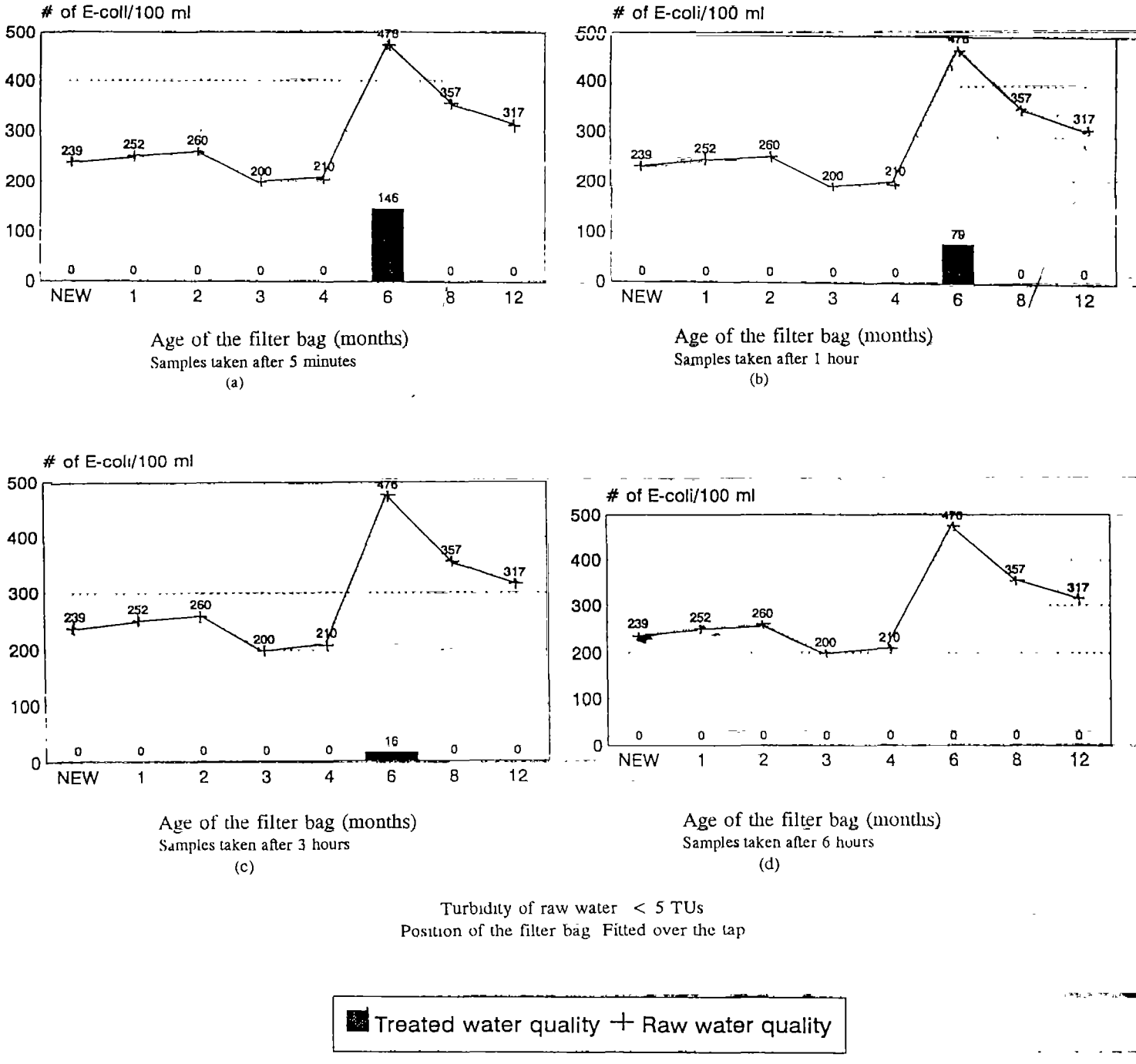


Fig. 5.3 Bactericidal efficacy of filter bag in cooler # 1 (washed daily).

It was also observed that frequent washing of the bags resulted in the deterioration of the bag-edges, letting the ingredients escape. The daily fitting and un-fitting of the holder clip also caused a slight rupture to the bag. The daily-washed bags had lost 90 to 120 grams of the initial weight after 6 months of use and 135 to 315 grams at the end of 12 months. Whereas the bag which was washed once a month has lost between 20 to 40 grams of weight after 6 months. The bags which were never washed have lost only 10 to 20 grams in six months. In the course of regular handling, frequent breakage of the holder clips was experienced. These clips are made of plastic. They have been discontinued by the manufacturer.

5.1.2 For the bags placed on the bottom of the coolers

For the bags placed on the bottom of the coolers and water drawn from the top, none of the bags was able to completely decontaminate the raw water in a five minute contact time, regardless of their age and washing frequency, for raw waters of contamination levels ranging between 102 to 375 *E.coli*/100 ml (see Fig. 5.4). The record earliest (complete) decontamination was achieved after a 2 hour contact time in only two cases where the BCL of the raw waters was considerably low i.e. 102 and 112 *E.coli*/100 ml, respectively (refer to Fig. 5.5). There are a few more cases where complete decontamination was obtained after 3 hours contact time. In the majority of the remaining cases, a 4 hour contact time was required for complete decontamination (see Figs. 5.6 and 5.7).

For a 5 minute contact time the bactericidal efficacy of the bags is generally below 50 percent, with a few exceptions, for the initial four months. It further decreases after this period. The 4 hour contact time proved to be effective for up to 4 months for the majority of cases (see Fig. 5.7). Beyond 4 months of use, a longer contact time was required generally to achieve a total disinfection. For the six month old bags, for a contact time of 5 minutes, the average decontamination for the five different bags is around 15 percent (see Fig. 5.8a). For the bags of the same age, only two out of five could achieve a complete decontamination after a contact time of 4 hours (see Fig. 5.8b). For a longer contact time i.e. 6 hours, the effectiveness of the bags remain valid up to a year. It was found that the bactericidal efficiency of the bags of the same age was generally similar regardless of their washing frequencies.

During the initial phase of these experiments, there was a shortage of laboratory consumables due to delayed supply. To economise on the available stock, some of the 5 minute and 30 minute samples were not undertaken. For example, the 5 minute samples of the new and the one month old bags were not conducted. However, this does not effect the analysis because the results of the consecutive samples are available. For example, for the bag washed daily, when the bag is new, the sample taken after 15 minutes shows a remaining contamination of 23 *E.coli*/100 ml (see Figure 5.4a), thus it is obvious that the test water was not decontaminated in five minutes. Similarly, for the bag washed every three days, when the bag is new and when it is one month old, the first sample was taken after 30 minutes of re-filling the cooler, (see Figure 5.4b).

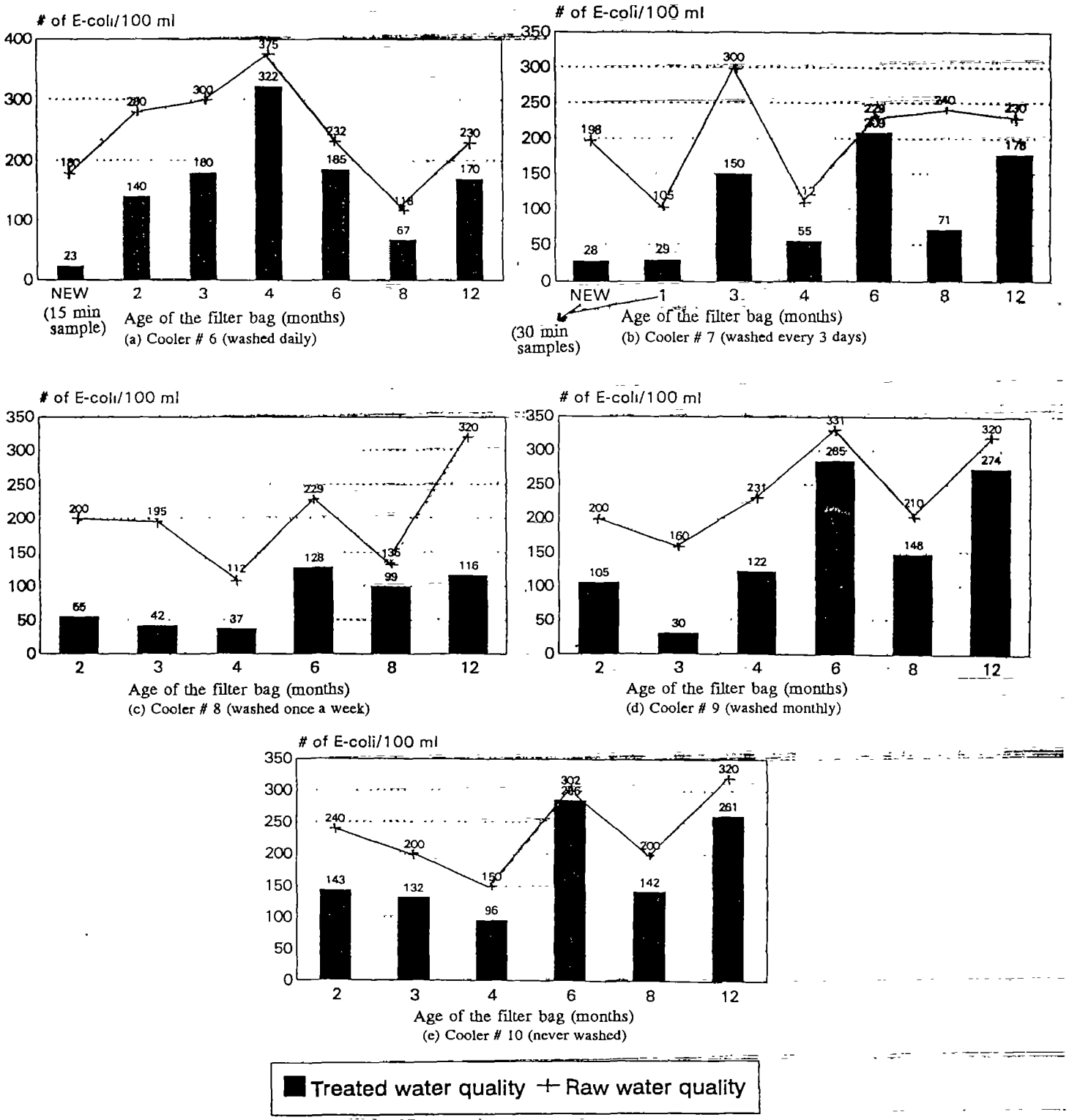
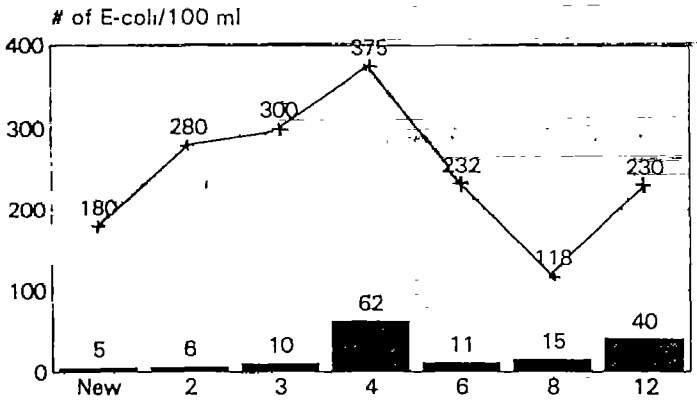
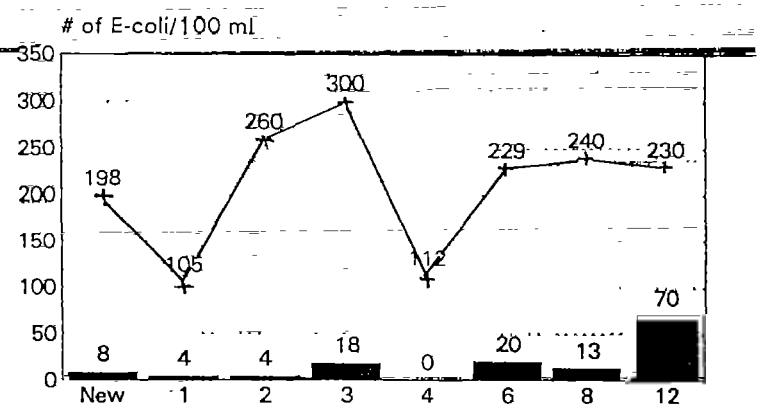


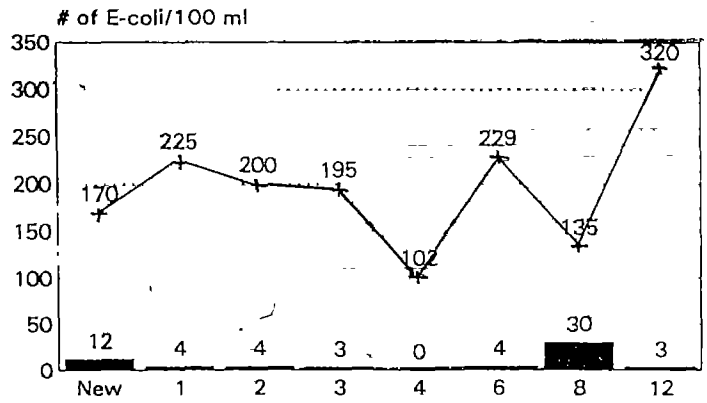
Fig. 5.4 Bactericidal efficacy of filter bags for samples taken 5 minutes after re-filling the cooler (time mentioned in parenthesis under 5.4a and 5.4b are the only cases where the 5 minute sample was not taken).



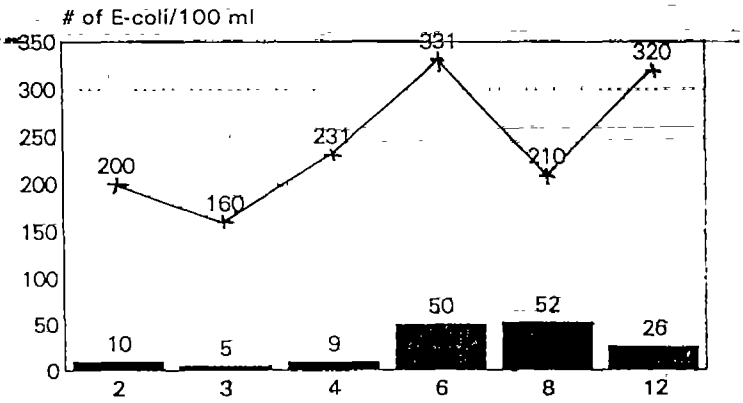
Age of the filter bag (months)
(a) Cooler # 6 (washed daily)



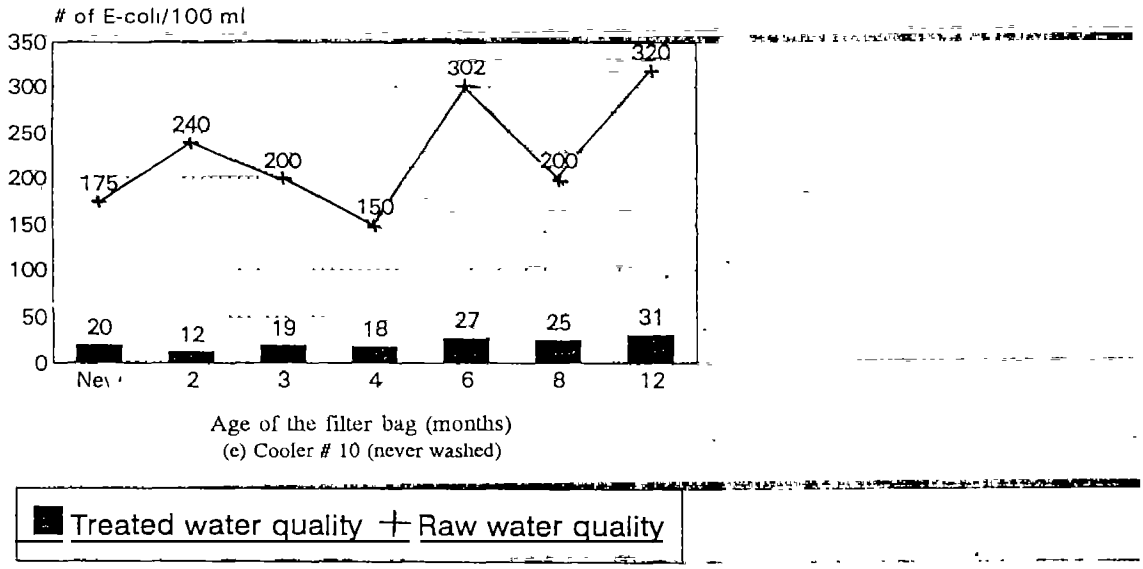
Age of the filter bag (months)
(b) Cooler # 7 (washed every 3 days)



Age of the filter bag (months)
(c) Cooler # 8 (washed once a week)

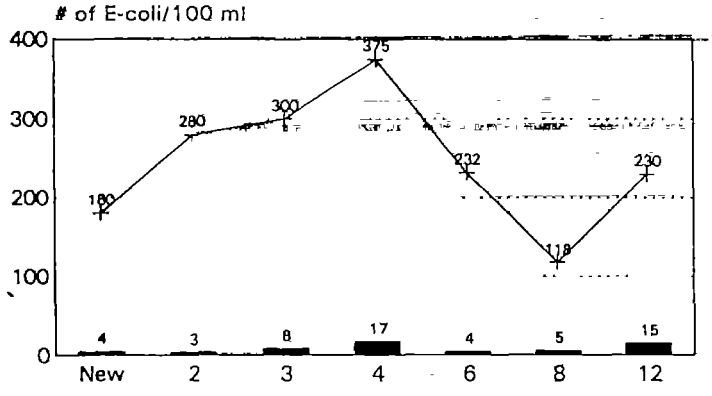


Age of the filter bag (months)
(d) Cooler # 9 (washed monthly)

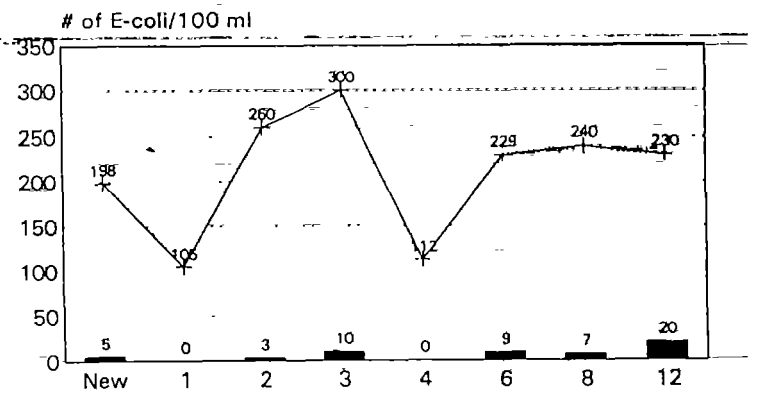


Age of the filter bag (months)
(e) Cooler # 10 (never washed)

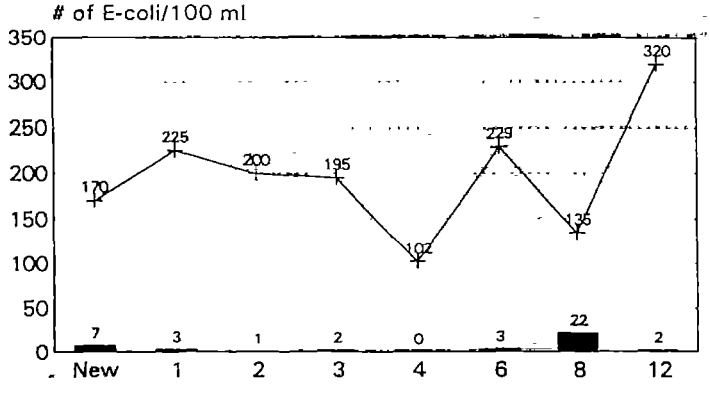
Fig. 5.5 Bactericidal efficacy of filter bags for samples taken 2 hours after re-filling the cooler.



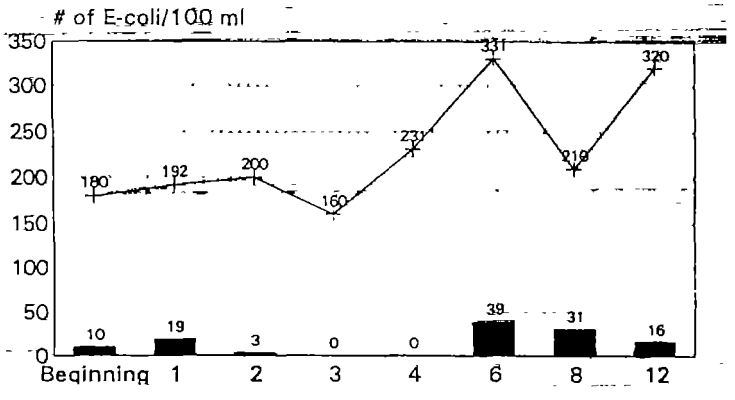
Age of the filter bag (months)
(a) Cooler # 6 (washed daily)



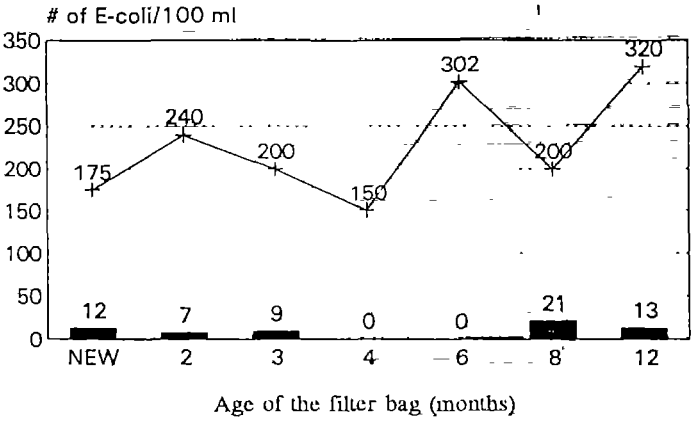
Age of the filter bag (months)
(b) Cooler # 7 (washed every 3 days)



Age of the filter bag (months)
(c) Cooler # 8 (washed once a week)



Age of the filter bag (months)
(d) Cooler # 9 (washed monthly)



Age of the filter bag (months)
(e) Cooler # 10 (never washed)

Treated water quality Raw water quality

Fig. 5.6 Bactericidal efficacy of filter bags for samples taken 3 hours after re-filling the cooler.

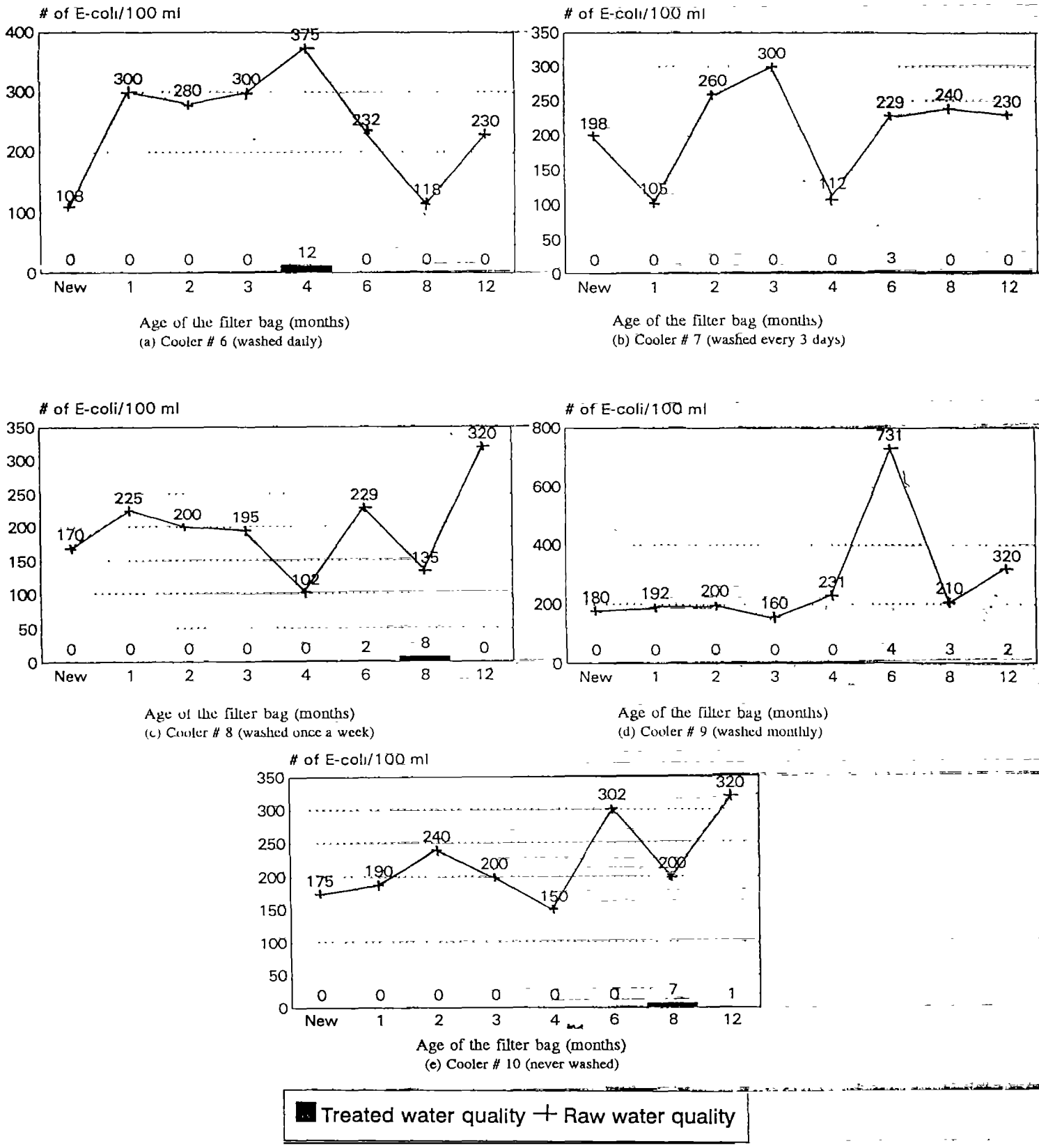
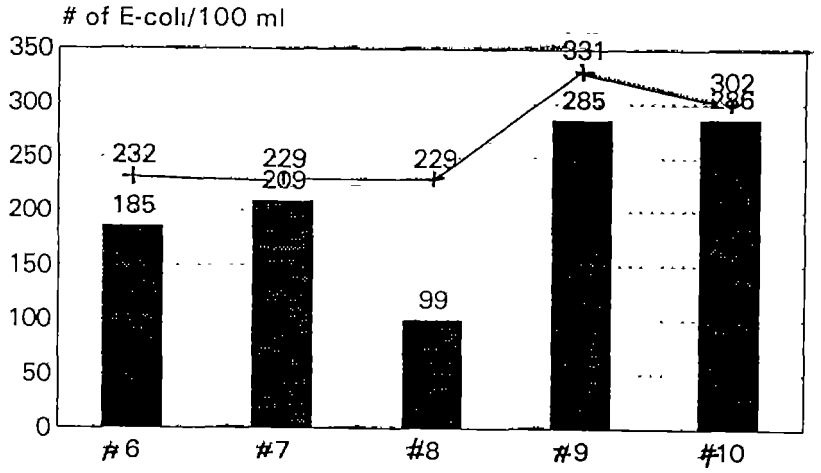
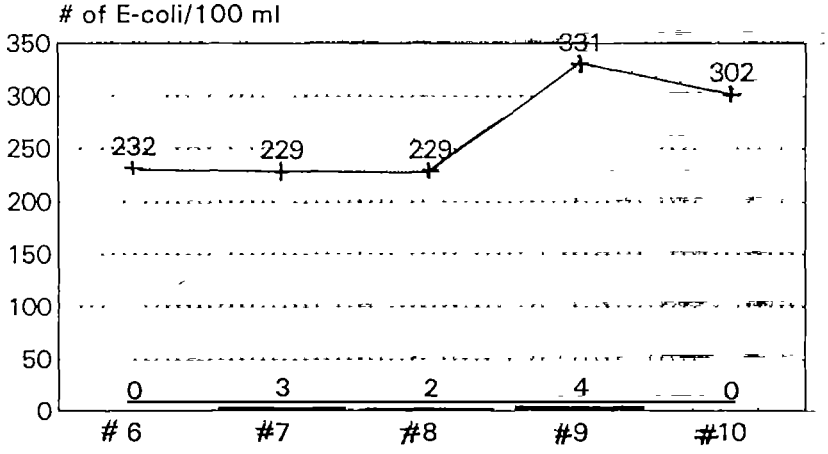


Fig. 5.7 Bactericidal efficacy of filter bags for samples taken 4 hours after re-filling the cooler.



Cooler reference number

(a) Residual contamination after 5 minutes contact time



Cooler reference number

(b) Residual contamination after 4 hours contact time

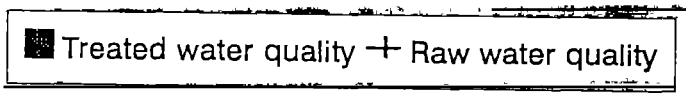


Fig. 5.8 Comparision of bactericidal efficacy of 6 month old filter bags.

5.2 Turbid, contaminated water (Phase II)

5.2.1 For the bags placed against the cooler taps

The Phase II experiments were conducted using Gilgit river water. In order to assess the bactericidal efficiency and flow rates for different turbidity waters, raw water samples of varying turbidities were prepared through dilution.

Since satisfactory flow-rates in the case of high turbidity waters with filter bags placed against the taps were not expected, it was decided to conduct the flow-rate measurements prior to undertaking any bactericidal efficiency tests. Table 5.2 shows data which was obtained for filling a glass of 250 ml with raw water of varying turbidity passing through the filter bags for different amounts of water in the coolers.

The turbidity level up to 1000 TUs is common for many of the rural drinking water sources in the area in the summer months. Considering the very low flow rates obtained, it was un-realistic to assume that in real life the bags will be used by placing them against the tap in the case of turbid waters. It was therefore decided to perform bactericidal efficiency tests for the turbid waters only with the filter bags placed on the bottom of the coolers.

Table 5.2 Time taken to extract 250 ml of water of varying turbidities passing through the Musaffa bags for different volumes of water in the coolers.

	Quantity of water in the cooler			
Raw-water Turbidity	Full (12 lit)	3/4 full (9 lit)	1/2 full (6 lit)	1/4 full (3 lit)
1900 TUs	5 min 32 sec	6 min 44 sec	10 min 13 sec	10 min 21 sec
700 TUs	3 min 21 sec	3 min 43 sec	5 min 14 sec	7 min 26 sec
500 TUs	2 min 51 sec	3 min 27 sec	3 min 49 sec	4 min 28 sec

5.2.2 For the bags placed on the bottom of the coolers

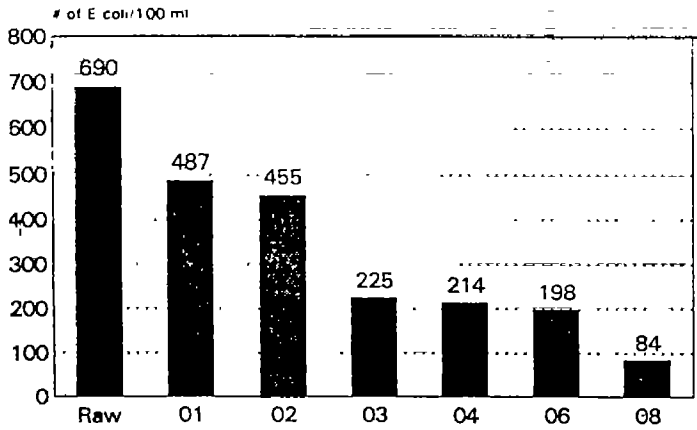
Five series of tests were conducted to the assess the bactericidal efficacy of the bags in raw waters by placing the bags on the bottom of the coolers. The Gilgit river water was used also for these experiments. Test waters of turbidities varying from 60 TUs to 1000 TUs were prepared by diluting the river water. All these experiments were conducted using new Musaffa bags. For each experiment, 8 samples were taken with a one hour interval.

The results of these experiments showed that in none of the cases, a complete decontamination was achieved even after 8 hours of contact time (see Fig. 5.9). It is evident from the data that the bactericidal efficacy of bag reduces significantly with the increase in the raw water turbidity. The level of decontamination using the raw water of turbidities ranging between 200 to 500 TUs was considerably less compared to that which was achieved using a raw water turbidity of 60 TUs, even though the later test-water was bacteriologically more contaminated. However, the outcome of the experiments with the lower turbidity waters was still unsatisfactory. On the basis of these disappointing results it was decided not to perform a prolonged series of tests like those carried out with clear but contaminated water.

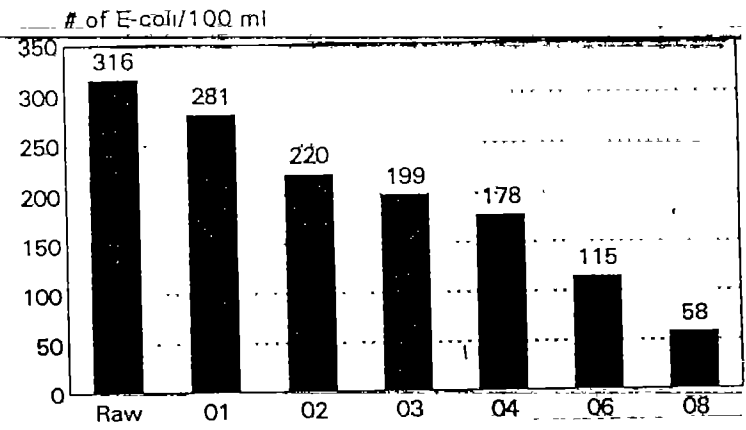
VI. MAJOR UNKNOWNS

Due to the lack of testing facilities, it was not possible to detect the concentration of silver in the treated water samples, since silver is the main source of disinfection in the Musaffa bag. According to the WHO Guidelines (1993), silver content up to 0.1 mg/litre could be tolerated by human without risk. However, it would be useful to verify that concentration of silver in the treated water does not exceed the above limit. In the course of sampling, the microbiologists experienced an unusual (bitter) taste in the treated water samples, especially those which were passed through the bags. Any definite reasons for this bad taste are not known, but are suspected to be either because of the silver content in the treated water, or due to possible dissolution of the filter media.

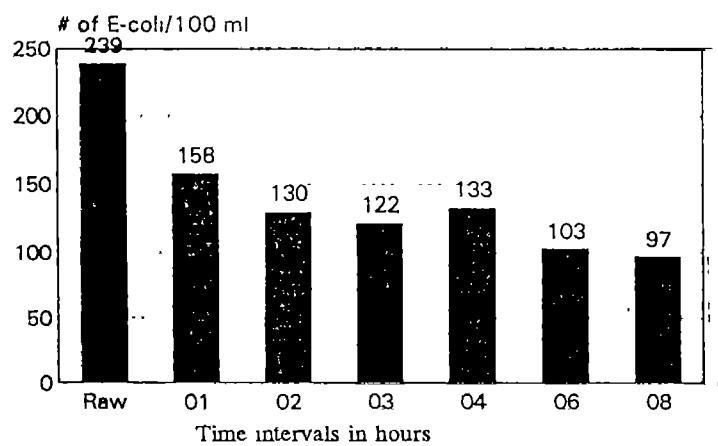
The organism/s which cause local diarrhoea is/are not known. Eficacy of the Musaffa bag has been assessed on the basis of its deactivation of *E.coli* only. It is not known how effective is the Musaffa bag in destroying any organisms other than *E.coli*.



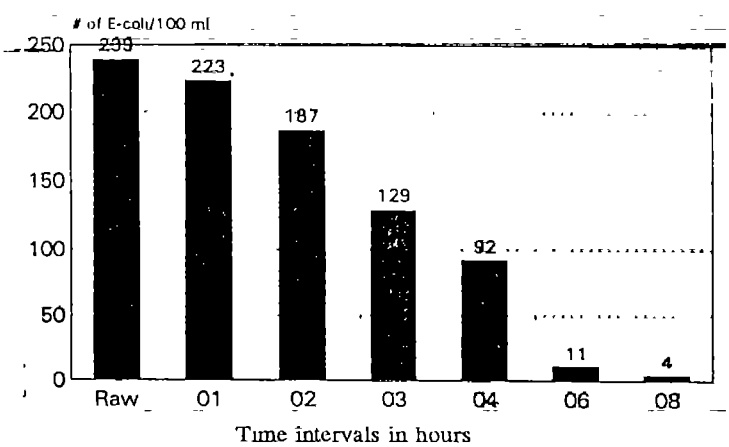
(a) Raw water Turbidity 1000 TUs



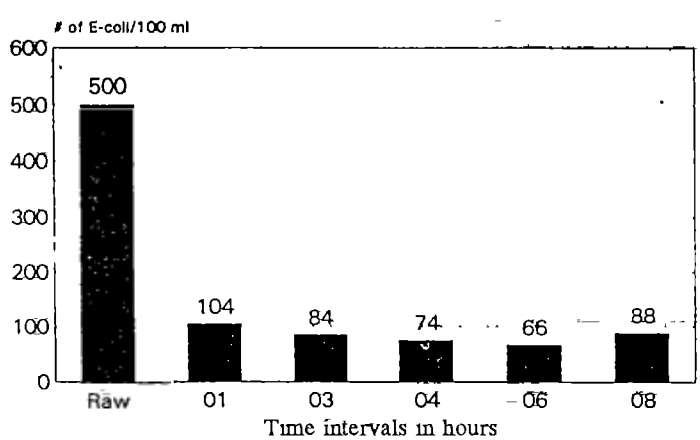
(b) Raw water Turbidity 500 TUs



(c) Raw water Turbidity 300 TUs



(d) Raw water Turbidity: 200 TUs



(e) Raw water Turbidity 60 TUs

Fig. 5.9 Bactericidal efficacy of filter bag in turbid water with the bag placed on the cooler bottom.

VII. CONCLUSIONS AND RECOMMENDATIONS

The recent promotion literature accompanying the Musaffa bag terms it the 'Matka technology'. It guarantees producing water with no harmful germs within 3 minutes of introducing the Musaffa bag to any type of water. The results of this indepth study do not support the aforementioned claim. It was concluded that under normal usage conditions i.e. with the bag placed at the bottom of the container, for non-turbid water, the bag is able to produce reasonably purified water only after four hours of contact time between the water and the bag. The bag is effective in achieving a quick decontamination effect when it is fitted against the tap, and when water passes through it. However, the user-guidelines with the currently produced Musaffa bags do not recommend any specific method of using the bag, other than to simply place the bag on bottom of the container.

While formulating the details of this experiment in early 1994, the general water quality conditions in the area were determined on the basis of the water quality studies carried out by the Project till the end of 1993. However, at the conclusion of the above studies in 1994, it was found out that the traditional water systems were even more contaminated than were found earlier. Compilation and analysis of the water quality data obtained during 1993-1994 shows that the average contamination level of the traditional water pits is 957 *E.coli*/100 for summer and 479 for winter (on the basis of 60 summer and 58 winter samples). Those for the water channels were found to be 580 *E.coli*/100 ml for summer and 378 for winter (141 summer and 168 winter samples over two years). The test waters which were used during the Musaffa study were generally less contaminated compared to the aforementioned typical values obtained from the water quality study (final report in process). Also, there was a noticeable decrease in the efficacy of the Musaffa bag when the raw water contamination levels exceeded 400 *E.coli*/100 ml. This calls for a more cautious approach when making any recommendations about the efficacy of the bag.

The limitation of the Musaffa bag in treating turbid waters was very clear. This was not unexpected, because for most chemical treatment techniques, optimum treatment is achieved with virtually no turbidity in the raw water. Turbidity levels above 5 NTUs are known to adversely effect the bactericidal processes.

The following are the main conclusions regarding the efficacy of the Musaffa water decontamination bag under different water quality conditions, and recommendations for the appropriate methods for its usage:

1. The Musaffa bag is not a promising option for treating turbid waters. When the filter bag is placed against the cooler-tap, the flow rate is very low so that it is unlikely to be used in this situation in real life. On the other hand, placed on the bottom of the container, even the new Musaffa bags were unable to produce decontaminated water after eight hours.

2. For clear waters (turbidity less than 5 TUs) having moderate bacteriological contamination levels (below 400 *E.coli*/100 ml) the Musaffa bag when placed on the bottom of the cooler, needs a much longer period for the decontamination process. The study found that after 4 hours of contact time, water was sufficiently purified. Data also indicate that after four months of use, longer contact time was required to produce decontaminated water. Under the aforementioned usage condition, the bag can be effective even up to a year.

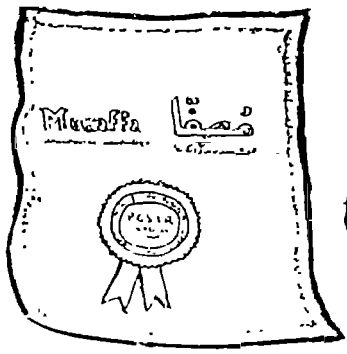
3. For non-turbid waters, an effective bactericidal performance of the Musaffa bag with a short contact time is only possible when the bag is placed against the cooler outlet and the raw water passes through the bag. In this case, provision of a holding clip must be considered. Even under the above condition, a longer contact time should be allowed than that which has been recommended in the Manufacturer's instructions.

4. Frequent washing of the bag has a counter productive effect on the bag's bactericidal efficiency and its physical condition. It is suggested that the bags should be washed only once per month.

To know more about the performance of the bag in everyday life i.e. in the households, sampling of the drinking water at some of the common user families was carried out. The study was conducted in Gilgit town during 1995. Data indicated that in low-turbid water the bag performed satisfactorily. The number of samples are however, too small to draw any firm conclusions. Also, all the tests were carried out at educated, well to do families living in urban conditions. The efficacy of the bag may be different in normal rural circumstances. Details of the rural subscribers have also been requested from the AKHB, on receipt of which a random sampling programme will be formulated for conducting in the villages.

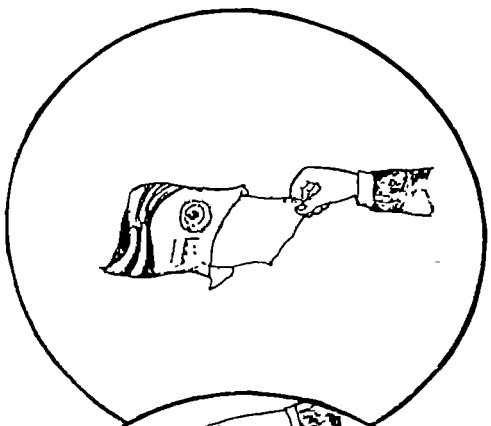
Considering AKHB's interest in promoting the Musaffa bag, it was decided to produce some locally appropriate user-instructions in Urdu in the form of a leaflet. These instructions take into consideration the appropriate contact time, washing frequencies, and efficacy of the bag in turbid waters. Concerned personal in the AKHB were consulted while preparing this leaflet (see Annex).

ANNEX

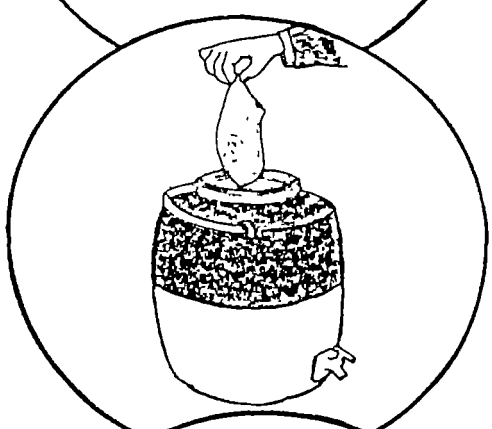


مُصفّا بیگ

پینے کے پانی میں موجود صحت کے لئے نقصان دہ جراثیم کو ختم کرتا ہے۔

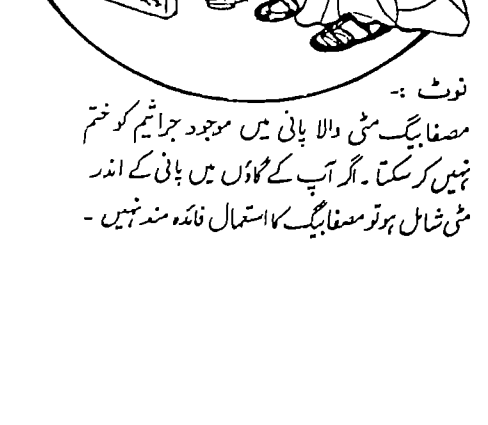


○ مُصفّا بیگ کو اِستعمال کرنے کیلئے پلاسٹک کی تھیلی سے نِکال دیں



○ مُصفّا بیگ کو پانی کے کولر، دیگچہ یا کِسی بھی بَرتن کی تہہ میں رکھیں اور اِس برتن میں 12 لیٹر سے زِیادہ پانی نہ ڈالیں (درمیانہ سائز کا کولر)

○ یہ پانی 4 گھنٹے بعد پینے کے لئے اِستعمال کریں۔



○ کولر، دیگچی یا کِسی اور بَرتن کو دھوتے وقت مُصفّا بیگ کو صاف جگہ پر رکھیں۔

○ مُصفّا بیگ کی بہتر کارکردگی کے لئے ضروری ہے کہ اِسے مہینے میں صرف ایک دفعہ دھولیں۔

ایک مُصفّا بیگ 6 ماہ تک اِستعمال کر سکتے ہیں
یہ گرمی اور سردی دونوں موسموں کے لئے برابر کا مفید ہے

نوٹ :-
مصفا بیگ مٹی والا پانی میں موجود جراثیم کو ختم نہیں کر سکتا۔ اگر آپ کے گاؤں میں پانی کے اندر مٹی شامل ہو تو مصفا بیگ کا استعمال فائدہ مند نہیں۔