

CONSUMER RIGHTS COMMISSION OF PAKISTAN

AND

PAKISTAN COUNCIL OF RESEARCH IN WATER RESOURCES  
MINISTRY OF SCIENCE & TECHNOLOGY  
GOVERNMENT OF PAKISTAN

QUALITY ANALYSIS OF  
BOTTLED MINERAL WATER

March, 2001

## How the Report on Bottled-Water was made Public?

Consumer Rights Commission of Pakistan (CRCP) under its “campaign for Safe Drinking Water” started working on drinking water in 1998 in view of increased number of complaints about the quality of water being provided by civic agencies in Rawalpindi / Islamabad. In the opinion of experts, about 80 per cent diseases and 40% deaths are attributed to water-borne disease, the primary reason being the fact that most of water being provided by civic agencies was contaminated. Perturbed by these Reports, CRCP decided to immediately initiate work within whatever meager resources were available. Idea was not to wait for funding but to start working.

First of the CRCP’s activities on water was to hold a seminar in Islamabad in which renowned experts on water were invited to apprise the citizens on the quality of water and possible precautionary measures. During the meeting, one expert from Pakistan Council for Research on Water Resources (PCRWR) pointed out that even many of the bottled-water brands available in the market were not fit for human consumption. For this, he referred to a study which had been carried out by the PCRWR. When asked to disclose the names of unfit brands, participants were informed that it was confidential information and, therefore, could not be shared. Only the percentages of fit or unfit brands could be made public. This shocked the participants. Many demanded that PCRWR, being a public organization under the Ministry of Science and Technology, must disclose this information in the public interest. But, for PCRWR, as for most governmental organizations, public interest lied in strict confidentiality.

In the following years, besides working on the water supply by civic bodies, CRCP continued to raise objections to the PCRWR attitude for keeping the results of its tests confidential. Issue was raised in almost all the related conferences and seminars, besides informing the general public through media. CRCP also wrote to high ranking government officials but of no avail. A number of officials thought that a disclosure of brand names would discourage business. Some feared civil suits by the faulting bottled-water companies. Others dismissed the issue as tiny and insignificant, as it involved only a small number of elite and privileged. For CRCP, however, the issue was that of the promotion of socially responsible business and to discourage those who harm public health by providing substandard goods. It was also an issue of freedom of information.

By 2000, few other citizen groups and individual activists had also started putting pressure on PCRWR to make the results public. By now, however, the previous results had become too old to be considered authentic. Besides, PCRWR was now taking the position that, while conducting the tests, it had not fulfilled all the legal requirements and, therefore, disclosure was not advisable. In view of this situation, Minister for Science and Technology, Dr. Atta-ur-Rehman, instructed PCRWR to conduct tests of bottled-water brands afresh. This, for a while, created panic among the concerned officials; who feared all kind of adverse implications. CRCP and PCRWR decided to meet all the legal requirements and make the results public. In a series of meetings CRCP and PCRWR finalized the sampling methodology, and complied with the procedures to fulfill the legal requirements. CRCP also decided to get some of the brands counter-tested from the private laboratories in order to cross check the validity of PCRWR results before making them public. CRCP extended its support but, on the understanding, that the entire process will be transparent and that the Report will be made public. From then onward, CRCP was part of the whole process, from developing sample-collection methodology to engaging district administration, sample-collection and getting some of the brands counter-tested from private laboratories including Excel, Nayab and Sifa Hospital. The report was ready by mid-March, but, once again, PCRWR, started showing reluctance in making it public. Efforts were on to again shelve the Report.

When PCRWR did not respond to a number of calls, faxes and letters, CRCP brought this situation in the knowledge of other activists on water, besides directly writing to the Minister, Dr. Atta-ur-Rehman. The Minister informed CRCP, through his email dated March 28, 2001 that he had directed the Secretary, Science and Technology, to make the results public. CRCP immediately wrote to the Secretary as to how and when he proposed to make the results public. Later, on April 11, 2001 CRCP team had a meeting with the Secretary. He had some concerns as to whether all the legal requirements had been met in the

entire exercise, from sample-collection to compilation of results. CRCP team explained that all such requirements had been met and there was no justification whatsoever to keep the Report confidential. He agreed, although would like to have the legal opinion first. Final decision, however, was made when the Minister again gave clear-cut instructions. That is how the Report on the Quality of Bottled-Water was released for the first-time ever in Pakistan on April 18, 2001.

Currently, CRCP is pursuing the districts administration nation wide to take immediate action against the producers and distributors of unfit brands. As a first step, we impress that all the faulty brands must immediately be withdrawn from the market, besides closing their further production and distribution until rectification. Cases must also be initiated against those who have been fleecing consumers against faulty brands and thus endangered public health.

Moral Of The Story Is That Citizens Must Act For Their Rights Because Results Can Be Achieved Through Persistent And Collaborative Efforts.

Under “campaign for Safe Drinking Water”, CRCP has been involved in the following specific activities over the past two years:

- (a) Complaint processing of short water supply and supply of water not fit for human consumption;
- (b) Issues involved in the rationing pattern of water during the time of water shortage from the perspective of urban poor;
- (c) Engagement with Capital Development Authority (CDA), Islamabad, and Water and Sanitation Authority (WASA), Rawalpindi, on issues related to availability, accessibility, and quality of drinking water;
- (d) Awareness drive among consumers, particularly the urban poor, on the significance of safe drinking water from public health perspective; and (e) Promotion of sustainable and socially responsible consumption patterns.

Currently, CRCP is engaged in Tap Water testing in Rawalpindi and Islamabad to determine the quality of water being supplied by the civic agencies. Problems related to water can be registered with Consumer hot line at CRCP



## **INTRODUCTION**

The safe drinking water is a basic right of all irrespective of their social status and economic conditions. The fast growth of population and consequent increase in urbanization has depleted the potable water resources. The situation of safe drinking water in big cities has aggravated to such an extent that a large number of people are compelled to use the most expensive bottled mineral water. A mushroom growth of bottled water is witnessed in the market over last few years due to high economic returns.

The term “Bottled Water” is defined as potable water obtained from an approved underground source of water and preserved in a sealed container for human consumption. The bottled water manufacturing firms are marketing their brands with attractive slogans. The Pakistan Council of Research in Water Resources (PCRWR) conducted a research study in 1998 to evaluate the quality of bottled water brands available in the market. At that time, 26 brands were collected and analyzed for 17 water quality parameters (physico-chemical & bacteriological). About 30 percent water samples were found unfit for drinking purpose due to bacterial contamination. Also much variation in the labeled constituents of bottled water than actual constituents was found in most of the brands. The paper was presented and published in the proceedings of the national workshop on “Water Resources Achievements and Issues in 20<sup>th</sup> Century and Challenges for the Next Millennium”.

After two years, findings of the study were published in the national press. As a result, general public and consumer associations demanded detailed analysis of mineral water brands and release of results to press. In view of queries by media regarding contaminated bottled water, the Honorable Federal Minister for Science & Technology directed PCRWR to undertake a fresh water quality analysis of bottled water brands available in the market.

## **ANALYSIS OF MINERAL WATER BRANDS**

In total 21 available brands of bottled water being marketed in Islamabad and Rawalpindi were collected. In order to make the water quality testing process transparent, PCRWR collected bottled water samples randomly from public utility stores and shops of Islamabad and Rawalpindi in collaboration with Consumer Rights Commission of Pakistan (CRCP), Local Administration (Magistrate) and Food Control Authorities. A set of three samples of each brand was collected and sealed at site. Out of these, one sealed sample was handed over to the shopkeeper concerned at that very moment, one brought in the laboratory for analysis and one preserved in the water testing laboratory of PCRWR. Some additional samples were also collected and sent to Excel, Nayab and AL-Shifa laboratories for verification of accuracy of result of PCRWR. Codes were allotted to each brand for transparency and secrecy. The details of these codes allotted are shown at Table –1. Each water sample was analyzed for 24 water quality parameters comprising alkalinity, bicarbonate, calcium, carbonate, chloride, colour, electrical conductivity, fluoride, hardness, iron, magnesium, nitrate, nitrogen, odour, pH, potassium, sodium, sulfate, taste, total dissolved solids, turbidity, coliform, non coliform and escherichia coli in the PCRWR water quality laboratory at Islamabad. However, the analysis of some inorganic constituents, pesticides, radiological, organic chemicals and some microbiological parameters like fecal streptococci, enterobacter, salmonella etc. could not be carried out due to lack of facilities. The standard analytical methods were adopted for the determination of aesthetic, physico-chemical and bacteriological water quality parameters. The analysis results of all laboratories were compared well with each other. The comparison of results is shown in Table – 2. The water sample collection team comprised of following members.

1. Two technical members from PCRWR
2. One member from Administration i.e. City Magistrate
3. One member from CRCP
4. One member from Food Control Authority

## RESULT AND DISCUSSIONS

It was observed that 18 brands i.e. Aab-e-Sehat, Al-ain, Alpine, Aqua, Bahrain, Blue Sky, Britiana, Culligon, Gulf, Margalla, Mineralo, Natura, Saydon, Tanuf, The Everest Valley, VIP Rakaposhi and Wah Waters were disappeared from the market while 13 new brands i.e. Aqua Flow, Aqua Safe, Brecon Carreg, Evian, Fresh, Max Wellpur, Musaffa, Niagra, Pearl, Perrier, Safa, Wellgreen and Zam Zam in the market. Only eight brands i.e. Nestle, Ava, Sparklets, Masafi, Cool, Ab-e-Hayat, Rainbow and Himalaya showed consistency in selling their products.

A sample of 21 available bottle water brands included Ab-e-Hayat, Aqua Flow, Aqua Safe, Ava, Brecon Carreg, Cool, Fresh, Evian, Himalaya, Masafi, Max Wellpur, Musaffa, Nestle, Niagra, Pearl, Perrier, Rainbow, Safa, Sparklets, Wellgreen and Zam Zam was collected and analyzed the quality evaluation of mineral water brands. All together 24 water quality parameters including chemical and microbiological were analyzed. Only 10 brands out of 21 (47.62%) i.e. "M1,, M2, M3, M6, M8, M16, M17, M19, M20 and M21" were found fit for drinking purpose because of microbiological quality. The remaining 11 brands (52.38%) i.e. "M4, M5, M7, M9, M10, M11, M12, M13, M14, M15 and M18" including one imported brand (claimed) are found unsafe for human consumption. The analytical results are shown at Table-3.

The chemical analysis have shown variations ranging from -99 to 1067% (minus percentage means < claimed values) between the claimed and actual values. Five brands i.e. (M2, M13, M14, M17 and M19) showed more compatibility of labeled with actual parameters (>+100% variation). In some samples, the variations in labeled and actual values were very high (+300% in some parameters) i.e. "M4, M6, M9, M16 and M18". It is a matter of interest that one brand has labeled the concentration of Potassium as 19.10 mg/l which is much higher than European Community (EC) standards of 12 mg/l (WHO, IBWA & PSI have not set standards for potassium). However, analytical value was 3.2 mg/l which was 83.25% less than labeled value and also within safe limit. Unfortunately, chemical composition has been labeled arbitrarily by the firms which reflects more interest in money making than quality control measures. Nevertheless, analyzed physico-chemical quality of most brands was found within the maximum permissible limits. The minimum and maximum values (claimed and actual) for analyzed water quality parameters of different brands are given in Table - 4. The quality assurance results of three laboratories are found almost the same in respect of microbiological analysis. These analysis reports are attached at Annexure —I-III.

## RECOMMENDATIONS

1. The preset situation of water quality of bottled water is due to lack of legislation for water quality control. There should be a legal organization for monitoring and regulation of drinking water.
2. There should be a uniform system for internal quality control, external quality assessment and hygienic practices in the bottled water industry. The source of each industry should also be properly assessed and certified by an authorized agency.
3. There should be a central well equipped water quality laboratory which will act as the certification laboratory for all other laboratories available in the country. Standard water quality analysis laboratories should be established in all provincial Headquarters as well.

**Table – 1**  
**Bottled Water Brands and Laboratory Codes**

<b>S. No.</b>	<b>Brand Code</b>	<b>Brand Name</b>	<b>Quantity</b>
1.	M1	Niagra	1 ½ Litre
2.	M2	Nestle	1 ½ Litre
3.	M3	Ava	1 ½ Litre
4.	M4	Sparklets	1 ½ Litre
5.	M5	Masafi	1 ½ Litre
6.	M6	Aqua Safe	1 ½ Litre
7.	M7	Cool	1 ½ Litre
8.	M8	Ab-e-Hayat	1 ½ Litre
9.	M9	Rainbow	½ Litre
10.	M10	Pearl	1 ½ Litre
11.	M11	Safa	1 ½ Litre
12.	M12	Zam Zam	1 ½ Litre
13.	M13	Fresh	1 ½ Litre
14.	M14	Musaffa	1 ½ Litre
15.	M15	Wellgreen	1 ½ Litre
16.	M16	Aqua Flow	1 ½ Litre
17.	M17	Max Wellpur	1 ½ Litre
18.	M18	Himalaya	1 ½ Litre
19.	M19	Brecon Carreg	2 Litre
20.	M20	Evian	1 ½ Litre
21.	M21	Perrier	1 Litre

**Table – 2**  
**Microbiological Comparison From Different Laboratories**

<b>S. No.</b>	<b>Brand Code</b>	<b>Water Quality Parameters</b>	<b>PCRWR Lab.</b>	<b>Excel Lab.</b>	<b>Nayab Lab.</b>	<b>Al-Shifa Lab.</b>
1.	M2	MPN (Coliform)/100ml MPN (E. Coli)/100 ml	Nil Nil	Nil Nil	-- --	Nil Nil
2.	M3	MPN (Coliform)/100 ml MPN (E. Coli)/100 ml	Nil Nil	Nil Nil	Nil Nil	--
3.	M4	MPN (Coliform)/100 ml MPN (E. Coli)/100 ml	12 Nil	-- --	Nil* Nil	1** Nil

\* Colony count 10 in 1 ml water sample

\*\* Total plate count 240 C.F. U/ml and presence of pseudomonas spp.



**Table – 3 Claimed And Analyzed Values of Bottled Water Samples**

Sr. No.	Parameters	Unit	WHO	IBWA	PSI		M1			M2			M3		
					MAC*	MAC**	Cli.	Act	%*	Cli	Act	%	Cli	Act	%
1	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	-	4.4	-	-	0.4	-	-	0.6	-
2	Bicarbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	92.7	210	126.54	25.4	20	-21.26	52	30	-42.31
3	Calcium	Mg/l	NGVS	NGVS	75	200	14.5	18	24.14	50.1	44	-12.18	22	16	-27.27
4	Carbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	-	5	-	-	Nil	-	-	Nil	-
5	Chloride	Mg/l	250	250	200	600	-	7	-	89	78	-12.36	-	37	-
6	Colour	TCU	15	NGVS	5	50	-	C.Less	-	-	C.Less	-	-	C.Less	-
7	E-Conductivity	US/l as CaCO3	NGVS	NGVS	NGVS	NGVS	-	593	-	-	348	-	-	228	-
8	Flouride	Mg/l	1.5	NGVS	-	NGVS	-	0.56	-	0.5	0.53	6.00	-	0.06	-
9	Hardness	Mg/l as CaCO3	NGVS	NGVS	20	500	-	100	-	-	130	-	100	80	-20.00
10	Iron	Mg/l	0.3	0.3	0.3	1	-	0.007	-	-	0.013	-	-	0.017	-
11	Magnesium	Mg/l	NGVS	NGVS	50	150	11.6	13	12.07	5	5	0.00	15	10	-33.33
12	Nitrate (N)	Mg/l	50	NGVS	-	45	-	0.4	-	-	0.3	-	-	0.7	-
13	Odour	-	O.Less	O.Less	O.Less	NGVS	-	O.Less	-	-	O.Less	-	-	O.Less	-
14	PH	-	6.5-8.5	NGVS	7-8.5	<9.2	7.2	8.4	16.67	-	7.01	-	75	7.4	-1.33
15	Potassium	Mg/l	NGVS	NGVS	NGVS	NGVS	19.1	3.2	-83.25	-	-	-	10	11	10.00
16	Sodium	Mg/l	200	NGVS	NGVS	NGVS	104	105	0.96	10	8	-20.00	6	18	200.00
17	Sulfate	Mg/l	250	250	200	400	-	48	-	20	21	5.00	-	1.5	-
18	Taste	-	Unobj.	Unobj.	Unobj.	NGVS	-	Unobj.	-	-	Unobj	-	-	Unobj	-
19	TDS	Mg/l	1000	500	1000	1500	451.9	410	-9.27	200	175	-12.50	180	126	-30.00
20	Turbidity	NTU	5	NGVS	5	25	-	0.5	-	-	0.4	-	-	0.4	-
21	Coliform	MPN/100 ml	Nil	Nil	Nil		-	Nil	-	Nil	Nil	-	-	Nil	-
22	N. Coliform	MPN/100 ml	Nil	Nil	Nil		-	Nil	-	Nil	Nil	-	-	Nil	-
23	E. Coli	MPN/100 ml	Nil	Nil	Nil		-	Nil	-	Nil	Nil	-	-	Nil	-
% age variation in chemical concentration (Cli vs. Act.)							-83 to 127			-21 to 6			-42 to 200		

Abberviations:

WHO	World Health Organization
IBWA	International Bottled Water Association
PSI	Pakistan Standards Institution
MAC	Maximum Acceptable Concentration
MAC	Maximum Allowable Concentration
Cli	Claimed Value
Act.	Actual Value
%	% inc (+)dec(-)over label vale
TCU	True Colour Unit
NTU	Nephelometric
MPN	Maximum Probable Number

Table – 3 Contd.....

Sr. No.	Parameters	Unit	WHO	IBWA	PSI		M4			M5			M6		
					MAC*	MAC**	Cli.	Act	%*	Cli	Act	%	Cli	Act	%
1	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	0.95	3.6	278.95	-	0.7	-	-	2.36	-
2	Bicarbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	116	180	55.17	41.2	35	-15.05	25.4	118	364.57
3	Calcium	Mg/l	NGVS	NGVS	75	200	44	56	27.27	3.6	8	122.22	50.1	16	-68.06
4	Carbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	1	Nil	-	-	Nil	-	-	Nil	-
5	Chloride	Mg/l	250	250	200	600	5	3	-40.00	58.2	60	3.09	89	34	-61.80
6	Colour	TCU	15	NGVS	5	50	-	C.Less	-	-	C.Less	-	-	C.Less	-
7	E-Conductivity	US/l as CaCO3	NGVS	NGVS	NGVS	NGVS	-	440	-	-	307	-	-	430	-
8	Fluoride	Mg/l	1.5	NGVS	-	NGVS	-	0.12	-	0.02	0.06	200.00	0.5	0.08	-84.00
9	Hardness	Mg/l as CaCO3	NGVS	NGVS	20	500	230	210	-8.70	-	115	-	-	90	-
10	Iron	Mg/l	0.3	0.3	0.3	1	-	0.09	-	-	0.02	-	-	0.045	-
11	Magnesium	Mg/l	NGVS	NGVS	50	150	28.8	17	-40.97	19	23	21.05	5	12	140.00
12	Nitrate (N)	Mg/l	50	NGVS	-	45	1	1.3	30.00	6.3	0.6	-90.48	-	0.3	-
13	Odour	-	O.Less	O.Less	O.Less	NGVS	-	O.Less	-	-	O.Less	-	-	O.Less	-
14	PH	-	6.5-8.5	NGVS	7-8.5	<9.2	7.32	7.8	6.56	8.2	7.3	-10.98	-	7.4	-
15	Potassium	Mg/l	NGVS	NGVS	NGVS	NGVS	2.2	1.6	-27.27	1.06	1	-5.66	-	2	-
16	Sodium	Mg/l	200	NGVS	NGVS	NGVS	3.2	18	462.50	21.9	20	-8.68	10	66	560.00
17	Sulfate	Mg/l	250	250	200	400	25.64	11	-57.10	18.3	24	31.15	20	37	85.00
18	Taste	-	Unobj.	Unobj.	Unobj.	NGVS	-	Unob.	-	-	Unob	-	-	Unob	-
19	TDS	Mg/l	1000	500	1000	1500	-	273	-	185	184	-0.54	200	266	-33.00
20	Turbidity	NTU	5	NGVS	5	25	-	1.2	-	-	0.3	-	-	1	-
21	Coliform	MPN/100 ml	Nil	Nil	Nil		-	12	-	-	26	-	-	Nil	-
22	N. Coliform	MPN/100 ml	Nil	Nil	Nil		-	12	-	-	26	-	-	Nil	-
23	E. Coli	MPN/100 ml	Nil	Nil	Nil		-	Nil	-	-	Nil	-	-	Nil	-
% age variation in chemical concentration (Cli vs. Act.)							-57 to 462			-90 to 200			-84 to 560		

Abbreviations:

WHO	World Health Organization
IBWA	International Bottled Water Association
PSI	Pakistan Standards Institution
MAC*	Maximum Acceptable Concentration
MAC**	Maximum Allowable Concentration
Cli	Claimed Value
Act.	Actual Value
%	% inc (+) dec (-) over label vale
TCU	True Colour Unit
NTU	Nephelometric
MPN	Maximum Probable Number

Table – 3 Contd.....

Sr. No.	Parameters	Unit	WHO	IBWA	PSI		M7			M8			M9		
					MAC*	MAC**	Cli.	Act	%*	Cli	Act	%	Cli	Act	%
1	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	-	2.4	-	-	2.7	-	-	2.5	-
2	Bicarbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	185	120	-35.14	140	140	0.00	195	125	-35.90
3	Calcium	Mg/l	NGVS	NGVS	75	200	36	32	-11.11	38	54	42.11	55	40	-27.27
4	Carbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	-	Nil	-	-	Nil	-	-	Nil	-
5	Chloride	Mg/l	250	250	200	600	14	20	42.86	11	14	27.27	4.2	11	161.90
6	Colour	TCU	15	NGVS	5	50	-	C.Less	-	-	C.Less	-	-	C.Less	-
7	E-Conductivity	US/l as CaCO3	NGVS	NGVS	NGVS	NGVS	-	375	-	-	468	-	-	305	-
8	Fluoride	Mg/l	1.5	NGVS	-	NGVS	0.2	0.1	-50.00	-	0.1	-	0.4	0.1	-75.00
9	Hardness	Mg/l as CaCO3	NGVS	NGVS	20	500	-	150	-	-	210	-	250	140	-44.00
10	Iron	Mg/l	0.3	0.3	0.3	1	-	0.045	-	-	0.02	-	<0.02	0.02	-
11	Magnesium	Mg/l	NGVS	NGVS	50	150	12	17	41.67	8	18	125.00	27	10	-62.96
12	Nitrate (N)	Mg/l	50	NGVS	-	45	-	0.5	-	-	2.4	-	1.8	0.2	-88.89
13	Odour	-	O.Less	O.Less	O.Less	NGVS	-	O.Less	-	-	O.Less	-	-	O.Less	-
14	PH	-	6.5-8.5	NGVS	7-8.5	<9.2	7.5	7.7	2.67	7.2	7.6	5.56	7.7	7.8	1.30
15	Potassium	Mg/l	NGVS	NGVS	NGVS	NGVS	3	3.8	26.67	2	3.2	60.00	1.9	3.5	84.21
16	Sodium	Mg/l	200	NGVS	NGVS	NGVS	26	28	7.69	12	21	75.00	13	8	-38.46
17	Sulfate	Mg/l	250	250	200	400	22	30	36.36	17	39	129.41	-	11	-
18	Taste	-	Unobj.	Unobj.	Unobj.	NGVS	-	Unob	-	-	Unob	-	-	Unob	-
19	TDS	Mg/l	1000	500	1000	1500	298	225	-24.50	220	290	31.82	280	189	-32.50
20	Turbidity	NTU	5	NGVS	5	25	-	0.3	-	-	0.3	-	0.1	0.6	500.00
21	Coliform	MPN/100 ml	Nil	Nil	Nil		-	50	-	-	Nil	-	-	23	-
22	N. Coliform	MPN/100 ml	Nil	Nil	Nil		-	50	-	-	Nil	-	-	23	-
23	E. Coli	MPN/100 ml	Nil	Nil	Nil		-	Nil	-	-	Nil	-	-	Nil	-
% age variation in chemical concentration (Cli vs. Act.)							-50 to 43			0 to 129			-89 to 500		

Abbreviations:

WHO	World Health Organization
IBWA	International Bottled Water Association
PSI	Pakistan Standards Institution
MAC*	Maximum Acceptable Concentration
MAC**	Maximum Allowable Concentration
Cli	Claimed Value
Act.	Actual Value
%	% inc (+) dec (-) over label vale
TCU	True Colour Unit
NTU	Nephelometric
MPN	Maximum Probable Number

Table – 3 Contd.....

Sr. No.	Parameters	Unit	WHO	IBWA	PSI		M10			M11			M12		
					MAC*	MAC**	Cli.	Act	%*	Cli	Act	%	Cli	Act	%
1	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	-	4	-	1.42	3.8	167.61	-	0.5	-
2	Bicarbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	88	200	127.27	173.2	180	3.93	175	25	-85.71
3	Calcium	Mg/l	NGVS	NGVS	75	200	35	60	71.43	28.8	70	143.06	40	24	-40.00
4	Carbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	-	Nil	-	-	5	-	-	Nil	-
5	Chloride	Mg/l	250	250	200	600	35	20	-42.86	15.63	10	-36.02	13	16	23.08
6	Colour	TCU	15	NGVS	5	50	-	C.Less	-	-	C.Less	-	-	C.Less	-
7	E-Conductivity	US/l as CaCO3	NGVS	NGVS	NGVS	NGVS	-	545	-	-	518	-	-	264	-
8	Fluoride	Mg/l	1.5	NGVS	-	NGVS	0.4	0.12	-70.00	-	0.16	-	0.22	0.13	-40.91
9	Hardness	Mg/l as CaCO3	NGVS	NGVS	20	500	-	220	-	156	240	53.85	160	100	-37.50
10	Iron	Mg/l	0.3	0.3	0.3	1	-	0.05	-	0.02	0.045	125.00	-	0.045	-
11	Magnesium	Mg/l	NGVS	NGVS	50	150	10	17	70.00	20.16	15	-25.60	15	10	-33.33
12	Nitrate (N)	Mg/l	50	NGVS	-	45	-	1.2	-	2.2	1.3	-40.91	1.33	4.4	230.83
13	Odour	-	O.Less	O.Less	O.Less	NGVS	-	O.Less	-	-	O.Less	-	-	O.Less	-
14	PH	-	6.5-8.5	NGVS	7-8.5	<9.2	7.25	7.7	6.21	8.05	8.4	4.35	7.6	8.2	7.89
15	Potassium	Mg/l	NGVS	NGVS	NGVS	NGVS	0.8	1.2	50.00	1.8	1.8	0.00	1.2	1.7	41.67
16	Sodium	Mg/l	200	NGVS	NGVS	NGVS	18	26	44.44	18.39	15	-18.43	15	11	-26.67
17	Sulfate	Mg/l	250	250	200	400	12	23	91.67	28	43	53.57	-	57	-
18	Taste	-	Unobj.	Unobj.	Unobj.	NGVS	-	Unob.	-	-	Unob.	-	-	Unob.	-
19	TDS	Mg/l	1000	500	1000	1500	200	338	69.00	300	362	20.67	250	145	-42.00
20	Turbidity	NTU	5	NGVS	5	25	-	0.4	-	0.45	1.2	166.67	0.2	0.3	50.00
21	Coliform	MPN/100 ml	Nil	Nil	Nil		-	8	-	-	8	-	-	30	-
22	N. Coliform	MPN/100 ml	Nil	Nil	Nil		-	8	-	-	8	-	-	30	-
23	E. Coli	MPN/100 ml	Nil	Nil	Nil		-	Nil	-	-	Nil	-	-	Nil	-
% age variation in chemical concentration (Cli vs. Act.)							-70 to 127			-41 to 168			-86 to 231		

Abbreviations:

WHO	World Health Organization
IBWA	International Bottled Water Association
PSI	Pakistan Standards Institution
MAC*	Maximum Acceptable Concentration
MAC**	Maximum Allowable Concentration
Cli	Claimed Value
Act.	Actual Value
%	% inc (+) dec (-) over label vale
TCU	True Colour Unit
NTU	Nephelometric
MPN	Maximum Probable Number

Table – 3 Contd.

Sr. No.	Parameters	Unit	WHO	IBWA	PSI		M13			M14			M15		
					MAC*	MAC**	Cli.	Act	%*	Cli	Act	%	Cli	Act	%
1	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	-	4.2	-	-	3.6	-	-	0.6	-
2	Bicarbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	205	210	2.44	233	180	-23.73	22	30	36.36
3	Calcium	Mg/l	NGVS	NGVS	75	200	42	40	-4.76	30	36	20.00	22	20	-9.09
4	Carbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	-	Nil	-	-	Nil	-	-	Nil	-
5	Chloride	Mg/l	250	250	200	600	47	64	36.17	13	6	-53.85	81	67	-17.28
6	Colour	TCU	15	NGVS	5	50	-	C.Less	-	C.Less	-	-	-	C.Less	-
7	E-Conductivity	US/l as CaCO3	NGVS	NGVS	NGVS	NGVS	-	830	-	-	490	-	-	290	-
8	Fluoride	Mg/l	1.5	NGVS	-	NGVS	-	0.13	-	-	0.14	-	-	0.06	-
9	Hardness	Mg/l as CaCO3	NGVS	NGVS	20	500	-	270	-	-	200	-	-	100	-
10	Iron	Mg/l	0.3	0.3	0.3	1	-	0.04	-	-	0.045	-	-	0.03	-
11	Magnesium	Mg/l	NGVS	NGVS	50	150	21	41	95.24	23	18	-21.74	10	12	20.00
12	Nitrate (N)	Mg/l	50	NGVS	-	45	-	0.04	-	-	0.04	-	-	0.04	-
13	Odour	-	O.Less	O.Less	O.Less	NGVS	-	O.Less	-	-	O.Less	-	-	O.Less	-
14	PH	-	6.5-8.5	NGVS	7-8.5	<9.2	7.5	7.9	5.33	7.1	7.9	11.27	7.15	7.2	0.70
15	Potassium	Mg/l	NGVS	NGVS	NGVS	NGVS	4	4.3	7.50	3	4	33.33	6	6.8	13.33
16	Sodium	Mg/l	200	NGVS	NGVS	NGVS	85	94	10.59	61	45	-26.23	5	11	120.00
17	Sulfate	Mg/l	250	250	200	400	140	120	-14.29	48	30	-37.50	2	2	0.00
18	Taste	-	Unobj.	Unobj.	Unobj.	NGVS	-	Unobj.	-	-	Unobj.	-	-	Unobj.	-
19	TDS	Mg/l	1000	500	1000	1500	410	581	41.71	-	304	-	148	159	7.43
20	Turbidity	NTU	5	NGVS	5	25	-	0.3	-	-	0.2	-	-	0.2	-
21	Coliform	MPN/100 ml	Nil	Nil	Nil	-	-	13	-	-	13	-	-	23	-
22	N. Coliform	MPN/100 ml	Nil	Nil	Nil	-	-	13	-	-	13	-	-	23	-
23	E. Coli	MPN/100 ml	Nil	Nil	Nil	-	-	Nil	-	-	Nil	-	-	Nil	-
% age variation in chemical concentration (Cli vs. Act.)							-14 to 95			-54 to 33			-17 to 120		

Abbreviations:

WHO	World Health Organization
IBWA	International Bottled Water Association
PSI	Pakistan Standards Institution
MAC*	Maximum Acceptable Concentration
MAC**	Maximum Allowable Concentration
Cli	Claimed Value
Act.	Actual Value
%	% inc (+) dec (-) over label vale
TCU	True Colour Unit
NTU	Nephelometric
MPN	Maximum Probable Number

**Table – 3 Contd.**

Sr. No.	Parameters	Unit	WHO	IBWA	PSI		M16			M17			M18		
					MAC*	MAC**	Cli.	Act	%*	Cli	Act	%	Cli	Act	%
1	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	-	3.5	-	-	3.4	-	2.10	2.8	33.33
2	Bicarbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	195	165	-15.38	131.65	170	29.13	-	140	-
3	Calcium	Mg/l	NGVS	NGVS	75	200	55	44	-20.00	30.85	42	36.14	52	40	-23.08
4	Carbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	-	5	-	-	Nil	-	-	Nil	-
5	Chloride	Mg/l	250	250	200	600	4.2	49	1066.67	18	33	83.33	7	5	-28.57
6	Colour	TCU	15	NGVS	5	50	-	C.Less	-	-	C.Less	-	-	C.Less	-
7	E-Conductivity	US/l as CaCO3	NGVS	NGVS	NGVS	NGVS	-	628	-	-	587	-	-	360	-
8	Fluoride	Mg/l	1.5	NGVS	-	NGVS	0.4	0.2	-50.00	-	0.2	-	-	0.23	-
9	Hardness	Mg/l as CaCO3	NGVS	NGVS	20	500	250	205	-18.00	-	240	-	164	180	9.76
10	Iron	Mg/l	0.3	0.3	0.3	1	-	0.02	-	-	0.08	-	-	0.007	-
11	Magnesium	Mg/l	NGVS	NGVS	50	150	27	23	-14.81	33.29	32	-3.88	13	19	46.15
12	Nitrate (N)	Mg/l	50	NGVS	-	45	-	4	-	-	5.2	-	-	0.8	-
13	Odour	-	O.Less	O.Less	O.Less	NGVS	-	O.Less	-	-	O.Less	-	-	O.Less	-
14	PH	-	6.5-8.5	NGVS	7-8.5	<9.2	-	8.4	-	-	7.7	-	7.4	7.8	5.41
15	Potassium	Mg/l	NGVS	NGVS	NGVS	NGVS	1.9	2.8	47.37	3.5	3	-14.29	2	1	-50.00
16	Sodium	Mg/l	200	NGVS	NGVS	NGVS	13	43	230.77	35.3	42	18.98	1	4	300.00
17	Sulfate	Mg/l	250	250	200	400	-	40	-	32.88	49	49.03	6	12	100.00
18	Taste	-	Unobj.	Unobj.	Unobj.	NGVS	-	Unob	-	-	Unob.	-	-	Unob.	-
19	TDS	Mg/l	1000	500	1000	1500	280	389	38.93	406	364	-10.34	-	223	-
20	Turbidity	NTU	5	NGVS	5	25	-	0.6	-	-	0.2	-	-	0.6	-
21	Coliform	MPN/100 ml	Nil	Nil	Nil	-	-	Nil	-	-	Nil	-	-	6	-
22	N. Coliform	MPN/100 ml	Nil	Nil	Nil	-	-	Nil	-	-	Nil	-	-	6	-
23	E. Coli	MPN/100 ml	Nil	Nil	Nil	-	-	Nil	-	-	Nil	-	-	Nil	-
% age variation in chemical concentration (Cli vs. Act.)							-50 to 1067			-14 to 83			-50 to 300		

**Abbreviations:**

WHO	World Health Organization
IBWA	International Bottled Water Association
PSI	Pakistan Standards Institution
MAC*	Maximum Acceptable Concentration
MAC**	Maximum Allowable Concentration
Cli	Claimed Value
Act.	Actual Value
%	% inc (+) dec (-) over label vale
TCU	True Colour Unit
NTU	Nephelometric
MPN	Maximum Probable Number

Table – 3 Contd.

Sr. No.	Parameters	Unit	WHO	IBWA	PSI		M19			M20			M21		
					MAC*	MAC**	Cli.	Act	%*	Cli	Act	%	Cli	Act	%
1	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	-	3.2	-	-	4.9	-	-	4	-
2	Bicarbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	206	160	-22.33	357	245	-31.37	-	200	-
3	Calcium	Mg/l	NGVS	NGVS	75	200	47.5	48	1.05	78	60	-23.08	-	160	-
4	Carbonate	Mg/l	NGVS	NGVS	NGVS	NGVS	-	Nil	-	-	Nil	-	-	Nil	-
5	Chloride	Mg/l	250	250	200	600	13	13	0.00	4.5	12	166.67	-	28	-
6	Colour	TCU	15	NGVS	5	50	-	C.Less	-	-	C.Less	-	-	C.Less	-
7	E-Conductivity	US/l as CaCO3	NGVS	NGVS	NGVS	NGVS	-	390	-	-	564	-	-	770	-
8	Fluoride	Mg/l	1.5	NGVS	-	NGVS	-	0.1	-	-	0.1	-	-	0.14	-
9	Hardness	Mg/l as CaCO3	NGVS	NGVS	20	500	-	190	-	-	280	-	-	400	-
10	Iron	Mg/l	0.3	0.3	0.3	1	-	0.003	-	-	0.017	-	-	0.013	-
11	Magnesium	Mg/l	NGVS	NGVS	50	150	16.5	17	3.03	24	31	29.17	-	Nil	-
12	Nitrate (N)	Mg/l	50	NGVS	-	45	2.2	0.2	-90.91	3.8	0.4	-89.47	-	2	-
13	Odour	-	O.Less	O.Less	O.Less	NGVS	-	O.Less	-	-	O.Less	-	-	O.Less	-
14	PH	-	6.5-8.5	NGVS	7-8.5	<9.2	-	7.8	-	7.2	7.8	8.33	-	5	-
15	Potassium	Mg/l	NGVS	NGVS	NGVS	NGVS	0.4	0.5	25.00	1	1	0.00	-	0.6	-
16	Sodium	Mg/l	200	NGVS	NGVS	NGVS	5.7	6	5.26	5	7	40.00	-	10	-
17	Sulfate	Mg/l	250	250	200	400	9	7	-22.22	10	12	20.00	-	38	-
18	Taste	-	Unobj.	Unobj.	Unobj.	NGVS	-	Unobj.	-	-	Unobj.	-	-	Unobj.	-
19	TDS	Mg/l	1000	500	1000	1500	-	242.	-	-	350	-	-	477	-
20	Turbidity	NTU	5	NGVS	5	25	-	0.5	-	-	0.75	-	-	0.4	-
21	Coliform	MPN/100 ml	Nil	Nil	Nil	-	-	Nil	-	-	Nil	-	-	Nil	-
22	N. Coliform	MPN/100 ml	Nil	Nil	Nil	-	-	Nil	-	-	Nil	-	-	Nil	-
23	E. Coli	MPN/100 ml	Nil	Nil	Nil	-	-	Nil	-	-	Nil	-	-	NIL	-
% age variation in chemical concentration (Cli vs. Act.)							-91 to 25			-89 to 167			-		

Abbreviations:

WHO	World Health Organization
IBWA	International Bottled Water Association
PSI	Pakistan Standards Institution
MAC*	Maximum Acceptable Concentration
MAC**	Maximum Allowable Concentration
Cli	Claimed Value
Act.	Actual Value
%	% inc (+) dec (-) over label vale
TCU	True Colour Unit
NTU	Nephelometric
MPN	Maximum Probable Number

**TABLE-4 Minimum and Maximum Values Of Water Quality Parameters**

Sr. No.	Parameter	Unit	WHO	IBWA	PSI		Claimed Value		Actual Analyzed Value	
					MAC*	MAC**	Min.	Max.	Min.	Max
1.	Alkalinity	m.mol/l	NGVS	NGVS	NGVS	NGVS	0.95	2.10	0.40	4.90
2.	Bicarbonate	mg/1	NGVS	NGVS	NGVS	NGVS	22	357	20	245
3	Calcium	mg/1	NGVS	NGVS	75	200	3.6	78	8	160
4	Carbonate	mg/1	NGVS	NGVS	NGVS	NGVS	0	1	0	5
5.	Chloride	mg/1	250	250	200	600	4.2	89	3	78
6.	Fluoride	mg/1	1.5	NGVS	-	NGVS	0.02	0.5	0.06	0.56
7.	Hardness	mg/1	NGVS	NGVS	20	500	100	250	80	400
8.	Iron	mg/1	0.3	0.3	0.3	1	<0.02	0.02	0.003	0.09
9.	Magnesium	mg/1	NGVS	NGVS	50	150	5	33.29	0	41
10.	Nitrate (N)	Mg/1	50	NGVS	-	45	1	6.3	0.04	1.4
11.	pH		6.5-8.5	NGVS	7-8.5	<9.2	7.1	8.05	5	8.4
12.	Potassium	mg/1	NGVS	NGVS	NGVS	NGVS	1	19.10	0	11
13.	Sodium	mg/1	200	NGVS	NGVS	NGVS	1	85	4	105
14.	Sulfate	mg/1	250	250	200	400	2	140	2	120
15.	TDS	mg/1	1000	500	1000	1500	180	451.90	126	581
16.	Turbidity	NTU	5	NGVS	5	25	0.1	0.45	0.2	1.2

**Abbreviations;**

- WHO World Health Organization
- IBWA International Bottled Water Association
- PSI Pakistan Standard Institution
- NTU Nephelometric Turbidity Unit
- MPN Maximum Probable Number
- MAC\* Maximum Acceptable Concentration
- MAC\*\* Maximum Allowable Concentration.