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QUALITATIVE ASSESSMENT OF WATER SAMPLES FROM MISCELLINOUS PROVINCIAL LOCALE OF PAKISTAN

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ABSTRACT: Two hundred potable water samples were garnered from myriad rustic areas of Pakistan. These were perceptible by fifty illustrative individually from Khyber Pukhtoonkhuwa (KPK), Punjab, Sindh and Baluchistan. From the bacteriological appraisal, it was corroborated that indispensible turfs of Pakistan such has Sindh and Khyber Pukhtoonkhuwa aqua founts was hexed with boisterous total colony counts i.e. (38%) and (40%) on average for samples enthralling >5700 bacterial count. Abiding preposterous intensity of fecal *E.coli, Enterococci*, *Streptococci* and other pathogens cardinally *Pseudomonas, Clostridia* pose inimical predicament by ameliorating recrudescence of water borne contagion. The deemed magnitude of sullied potable water is (52%) which according to World Health Organization (WHO), this grade of water is bacteriologically ominous and government and citizenry should apprehend worthwhile and optimistic approaches to cope the egregious circumstance of the country.

KEYWORDS: Potable water, Bacteriological, Pakistan.

INTRODUCTION

Water is pre-eminent and pertinent bounty of the Mother Nature. Humanity wields these quotidian resources to sustain oneself [1]. The terra firma of Pakistan is vapid and majority of strain depends on deliquescence of glaciers and annual rains for potable water. But faux adulteration of water had posed momentous ultimatum to esse on earth. Water resources are pared down per capita due to increasing population, capricious weather patterns and surplus exploitation of water. Provision of execrable quality of potable water have increased the morbidity rate of water borne illness including hepatitis, cholera, typhoid, gastro-enteric discomforts and cutaneous infections etc. According to UNICEF documentation mortality rate diahorreal illness is 2 million per annum which superintend for one third of demise [2]. Residuum of coliforms in potable water is crucial cause of water borne illness. In Pakistan, Nation Sanitation Policy and Natural Drinking water Policy ended in view to perk up water status in 2006 and 2009 at the expense of 4$ per capita. But execution of this convention remained debriefed, as annual ante is beneath the requirement. Appalling water standards is accountable for epidemics of oppressive water borne maladies. Guesstimated annually, three million natives are smote due to water borne afflictions [3]. Striking cataclysms in 2006 had surged over fundamental cities such as Peshawar, Karachi, Lahore and Faisalabad. Later on, Pakistan Council of Research in Water Resources surveiled quality of water from various quarters of Pakistan and the documented evaluation flaunted that pre-eminence of water from each substantial city was bacteriologically abysmal. The exposition declared tainted potable water reservoirs and possessed elevated level of coliforms, higher concentrations of iron and fluoride along with 73% turbidity. As claimed by United Nation Children's Fund investigation, approximately 20 - 40% children are hospitalized due to water borne illness and this condition may account for escalating mortality and morbidity rates which affects the daily wage and income of the family by procuring treatment for the ailments. According to Pakistan Supreme Court ordinance, ingurgitation of secure potable water is the quintessential prerogative of nation across the country [4].

The cardinal proposition of this research interpretation was to amass fifty potable water samples each from quotidian founts of the four provinces of Pakistan i.e. Khyber Pukhtoonkhuwa, Punjab, Baluchistan and Sindh. These samples were then analyzed for qualitative bacteriological atonements interrogating Total colony counts/ml, Total coliforms/ml, Presence of fecal *E.coli, Enterococci, Streptococci* and other micro-organism/ml.

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MATERIALS AND METHODS

SAMPLE COLLECTION

Fifty potable water from variegated provincial localities of Pakistan were tot up in 1000ml sample collector bottle. The collector bottles confine sodium thio-sulphide that aids to neutralize pH and maintain bacterial counts. Test samples included tap water, bore water, mineral water, tank water, spring water, well water, purified water from installed water purifiers and coolers, lake and river water from pertinent sectors of Khyber Pukhtoonkhuwa (KPK), Punjab, Sindh and Baluchistan. Clubbing together, two hundred water samples were put on to the bacteriological examination.

pH AND TEMPERATURE EXAMINATION

Speculated pH range for all the two hundred samples were 5.5 - 8.5 which was probed with aid of conventional comparator indicator strip. All the water samples were stowed at room temperature before prosecuting bacteriological examination.

BACTERIOLOGICAL EXAMINATION

Bacteriological examination of potable water samples were preceded via accessing total colony counts and identification of water borne micro-organisms.

a. TOTAL COLONY COUNT

Total colony counts of amassed water samples were scrutinized as per cited pour plate method [5]. 1ml water sample was subjected to autoclaved petri-plate. Then the water samples were spread commensurately with aid of sterilized spreader in the petri-plates. Then in laminar flow hood, prepared complex nutrient agar medium was poured over the water samples. Petri-plates were then left unperturbed at room temperature so that nutrient agar medium would gelatinize. Further the petri-plates were incubated at 37^{o}C for 24 hours in transpose position. At the end of incubation period, total bacterial counts were enumerated aiding digital colony counter.

b. IDENTIFYING MICRO-ORGAMNISMS

Identification of the water borne pathogens was scrutinized as per cited membrane filtration method [6]. 100ml water samples were filtered through cellulose ester membrane having pore size 0.45µm. After filtration, the membrane retained the bacteria on the surface eminently coliforms, fecal *E.coli, Enterococci, Streptococci* and other micro-organism such as *Pseudomonas* and *Clostridium* species. Cellulose membranes were then subjected to autoclaved bacterial selective medium extant in autoclaved petri-plates in a skyward position. Further the petri-plates were incubated at 37^{o}C for 24 hours. At end of incubation period, appeared bacterial colonies were enumerated on the basis of their perceptible color and morphology. Unwanted micro-organisms were either inhibited by composites present in selective medium or distinguished on basis of morphological traits.

RESULTS

KHYBER PUKHTOONKHUWA WATER SURVEY

From the evaluated result synopsized in (Table 1) and (Graph 1), it is apparent that potable water from circadian sources of Khyber Pukhtoonkhuwa (KPK) were indicted to be bacteriologically execrable due to the estimated samples holding higher total colony count i.e. >5700 was 20 out of 50 thus illustrating average of (40%), average presence of coliforms were (46%) for 23 isolated samples and average frequency of fecal *E.coli* were (30%) for 15 isolated samples which notifies alarming unsatisfactory water quality and escalating levels of water borne ailments specially in infants. Rare prevalence of fecal *Streptococci, Enterococci* (2%) and other organisms mainly *Pseudomonas* was inscribed.

Table 1: Tabular index proclaiming potable water recce of Khyber Pukhtoonkhuwa (KPK) precincts

SAMPLE NO.	KHYBER PUKHTOONKHUWA INVESTIGATIONS				
	TOTAL COLONY COUNT (CFU/ml)	TOTAL COLIFORMS (CFU/ml)	FECAL *E.COLI* (CFU/ml)	FECAL *STREPTOCOCCI/ ENTEROCOCCI* (CFU/ml)	OTHER ORGANISMS (CFU/ml)
1	1011	03	Isolated	-	-
2	<01	-	-	-	-
3	<01	-	-	-	-
4	>5700	-	-	-	-
5	<01	-	-	-	-
6	>5700	Numerous	Isolated	-	-
7	>5700	-	-	-	-
8	1325	-	-	-	-
9	>5700	25	-	-	-
10	1011	Numerous	Isolated	-	-
11	798	50	-	-	*Pseudomonas*
12	1410	25	-	-	-
13	370	15	Isolated	-	-
14	>5700	25	-	-	-
15	>5700	15	Isolated	Isolated	-
16	<01	-	-	-	-
17	<01	-	-	-	-
18	<01	-	-	-	-
19	<01	-	-	-	-
20	>5700	15	Isolated	-	-
21	17	-	-	-	-
22	>5700	-	-	-	-
23	>5700	6	Isolated	-	-
24	840	Numerous	-	-	-
25	1866	-	-	-	-
26	>5700	6	Isolated	-	-
27	02	-	-	-	-
28	940	-	-	-	-
29	>5700	60	Isolated	-	-
30	>5700	02	Isolated	-	-
31	>5700	02	Isolated	-	-
32	02	-	-	-	-
33	<01	-	-	-	-
34	>5700	-	-	-	-
35	>5700	13	Isolated	-	-
36	>5700	09	Isolated	-	-
37	08	-	-	-	-
38	03	-	-	-	-
39	<01	-	-	-	-
40	598	02	-	-	-
41	>5700	06	Isolated	-	-
42	>5700	09	-	-	-
43	121	15	Isolated	-	-
44	>5700	-	-	-	-
45	<01	-	-	-	-
46	<01	-	-	-	-
47	11	-	-	-	-
48	<01	-	-	-	-
49	1467	-	-	-	-
50	>5700	10	-	-	-

Key: (>5700) *denotes diabolical water sample that own exorbitant bacterial counts,*
(<01) *denotes veritable water sample that own few or no bacterial counts*

PUNJAB WATER SURVEY

From the results procured by Punjab potable water scrutiny, it was apparent that water quality in these regions at average moment was much same as Khyber Pukhtoonkhuwa's survey. Average of potable water samples that resides higher total colony count i.e. >5700 were (34%) for 17 observed samples, manifesting it as bacteriologically decrypted. Moderate prevalence of total coliforms was (34%) for 17 isolated samples and fecal *E.coli* (14%) for 7 isolated samples were computed. Rare to none fecal *Streptococci, Enterococci* (2%) and other organisms were observed. Results are synopsized in (Table 2) and (Graph 1).

Table 2: Tabular index proclaiming potable water recce of Punjab precincts

SAMPLE NO.	PUNJAB INVESTIGATIONS				
	TOTAL COLONY COUNT (CFU/ml)	TOTAL COLIFORMS (CFU/ml)	FECAL *E.COLI* (CFU/ml)	FECAL *STREPTOCOCCI/ ENTEROCOCCI* (CFU/ml)	OTHER ORGANISMS (CFU/ml)
1	2465	-	-	-	-
2	>5700	-	-	-	-
3	>5700	12	-	-	*Pseudomonas*
4	>5700	06	-	-	-
5	>5700	-	-	-	-
6	>5700	Numerous	-	-	-
7	<01	-	-	-	-
8	14	-	-	-	-
9	<01	-	-	-	-
10	48	-	-	-	-
11	13	-	-	-	-
12	1396	20	-	-	-
13	<01	-	-	-	-
14	1539	-	-	-	-
15	<01	-	-	-	-
16	1211	25	-	-	-
17	1368	25	-	-	-
18	<01	-	-	-	-
19	>5700	Numerous	-	-	-
20	<01	-	-	-	-
21	<01	-	-	-	-
22	16	-	-	-	-
23	484	-	-	-	-
24	03	-	-	-	-
25	>5700	50	-	-	-
26	>5700	-	-	-	-
27	53	24	-	-	-
28	<01	-	-	-	-
29	<01	-	-	-	-
30	>5700		-	-	-
31	>5700	Numerous	Isolated	-	-
32	>5700	02	-		-
33	641	-	-	-	-
34	08	-	-	-	-
35	1254	Numerous	Isolated	-	-
36	1054	30	Isolated	-	-
37	>5700	20	Isolated	Isolated	-
38	<01	-	-	-	
39	<01	-	-	-	-
40	741	-	-	-	-
41	<01	-	-	-	-
42	>5700	Numerous	Isolated	-	-
43	>5700	-	-	-	-
44	>5700	-	-	-	-

45	1140	-	-	-	-
46	>5700	-	-	-	-
47	>5700	02	Isolated	-	-
48	755	35	Isolated	-	-
49	570	-	-	-	-
50	71	-	-	-	-

Key: (>5700) *denotes diabolical water sample that own exorbitant bacterial counts,*
(<01) *denotes veritable water sample that own few or no bacterial counts*

SINDH WATER SURVEY

From Sindh water survey, we discerned that water from these sectors are also bacteriologically unsatisfactory and are insecure for consumption. Average total colony counts for water samples owing >5700 colony count was (38%) for 19 inspected samples, average of total coliforms was (58%) for 29 isolated samples, average persistence of fecal *E.coli* was (42%) for 21 isolated samples, average presence of other organisms such as *Clostridium* and *Pseudomonas* species was (8%) for 4 indicated samples. Results are synopsized in (Table 3) and (Graph 1). The awful water status from these areas poses a peril to health by inhabiting virulent organisms that are chief causative agents of gastro-intestinal illnesses.

Table 3: Tabular index proclaiming potable water recce of Sindh precincts

SAMPLE NO.	SINDH INVESTIGATIONS				
	TOTAL COLONY COUNT (CFU/ml)	TOTAL COLIFORMS (CFU/ml)	FECAL *E.COLI* (CFU/ml)	FECAL *STREPTOCOCCI/ ENTEROCOCCI* (CFU/ml)	OTHER ORGANISMS (CFU/ml)
1	>5700	20	Isolated	-	*Clostridia*
2	>5700	-	-	-	*Pseudomonas*
3	1140	Numerous	Isolated	-	-
4	>5700	-	-	-	-
5	>5700	Numerous	Isolated	-	-
6	>5700	45	Isolated	-	-
7	02	-	-	-	-
8	<01	-	-	-	-
9	58	02	-	-	-
10	741	80	Isolated	-	-
11	820	Numerous	Isolated	-	-
12	1197	Numerous	Isolated	-	-
13	>5700	25	Isolated	-	-
14	<01	-	-	-	-
15	02	-	-	-	-
16	>5700	Numerous	Isolated	-	-
17	427	01	-	-	-
18	370	25	Isolated	-	-
19	384	30	Isolated	-	-
20	<01	-	-	-	-
21	100	04	-	-	-
22	83	01	-	-	-
23	>5700	02	Isolated	-	-
24	584	06	Isolated	-	-
25	<01	-	-	-	-
26	<01	-	-	-	-
27	>5700	15	Isolated	-	-
28	>5700	-	-	-	-
29	1211	01	Isolated	-	*Pseudomonas*
30	<01	-	-	-	-
31	>5700	05	Isolated	-	-
32	>5700	02	Isolated	-	-
33	712	-	-	-	-
34	>5700	-	-	-	-
35	>5700	02	Isolated	-	-

36	>5700	Numerous	-	-	*Pseudomonas*
37	>5700	45	Isolated	-	-
38	<01	-	-	-	-
39	>5700	Numerous	-	-	-
40	441	-	-	-	-
41	<01	-	-	-	-
42	370	Numerous	-	-	-
43	<01	-	-	-	-
44	<01	-	-	-	-
45	<01	-	-	-	-
46	<01	-	-	-	-
47	<01	-	-	-	-
48	541	-	-	-	-
49	>5700	Numerous	Isolated	-	-
50	>5700	Numerous	Isolated	-	-

Key: (>5700) *denotes diabolical water sample that own exorbitant bacterial counts,*
(<01) *denotes veritable water sample that own few or no bacterial counts*

BALUCHISTAN WATER SURVEY

From regional water survey of Baluchistan sector, we perceive that in comparison to other provinces, the samples from these areas possessed less bacterial counts as notified (20%) on average for 10 isolated samples having colony counts observations >5700, (34%) for 17 isolated samples on average for total coliforms, (18%) for 9 isolated samples on average for regularity of fecal *E.coli.* Rare presence of other organisms mainly *Pseudomonas* and absence of fecal *Streptococci, Enterococci* was spotted. Results are synopsized in (Table 4) and (Graph 1). It is comparatively better result, but yet the elevated levels of coliforms and average bacterial counts contemplate this situation to be bacteriologically vulnerable as a whole.

Table 4: Tabular index proclaiming potable water recce of Baluchistan precincts

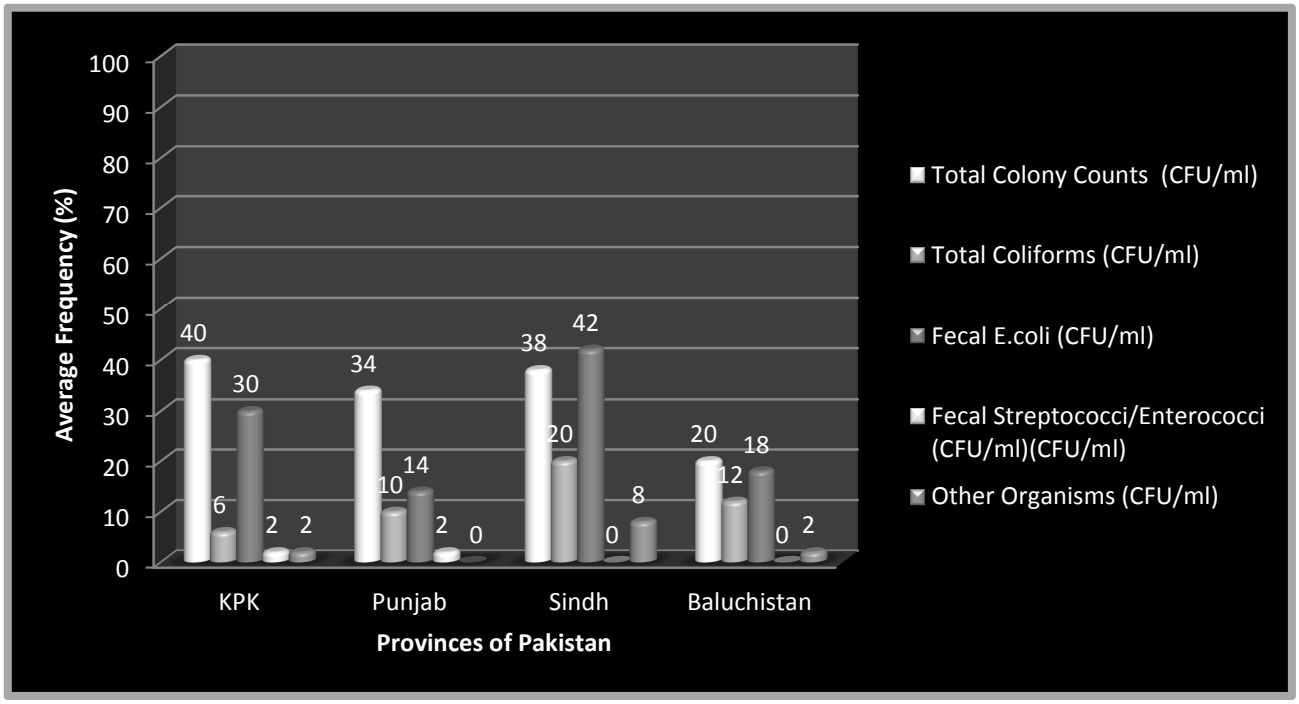
SAMPLE NO.	BALUCHISTAN INVESTIGATIONS				
	TOTAL COLONY COUNT (CFU/ml)	TOTAL COLIFORMS (CFU/ml)	FECAL *E.COLI* (CFU/ml)	FECAL *STREPTOCOCCI/ ENTEROCOCCI* (CFU/ml)	OTHER ORGANISMS (CFU/ml)
1	>5700	50	-	-	-
2	03	-	-	-	*Pseudomonas*
3	<01	-	-	-	-
4	<01	-	-	-	-
5	<01	-	-	-	-
6	<01	-	-	-	-
7	02	-	-	-	-
8	<01	-	-	-	-
9	1681	02	Isolated	-	-
10	270	-	-	-	-
11	<01	-	-	-	-
12	498	-	-	-	-
13	1524	-	-	-	-
14	66	-	-	-	-
15	<01	-	-	-	-
16	<01	-	-	-	-
17	>5700	Numerous	-	-	-
18	498	-	-	-	-
19	1396	09	Isolated	-	-
20	>5700	02	-	-	-
21	897	35	-	-	-
22	>5700	05	Isolated	-	-
23	>5700	Numerous	-	-	-
24	>5700	Numerous	Isolated	-	-
25	>5700	Numerous	Isolated	-	-

26	1410	Numerous	Isolated	-	-
27	02	-	-	-	-
28	<01	-	-	-	-
29	<01	-	-	-	-
30	01	-	-	-	-
31	01	-	-	-	-
32	>5700	-	-	-	-
33	<01	-	-	-	-
34	<01	-	-	-	-
35	1140	-	-	-	-
36	<01	-	-	-	-
37	01	-	-	-	-
38	01	-	-	-	-
39	812	09	Isolated	-	-
40	327	04	-	-	-
41	50	05	Isolated	-	-
42	>5700	02	-	-	-
43	812	02	-	-	-
44	<01	-	-	-	-
45	<01	-	-	-	-
46	<01		-	-	-
47	<01	-	-	-	-
48	<01	-	-	-	-
49	<01	-	-	-	-
50	>5700	Numerous	Isolated	-	-

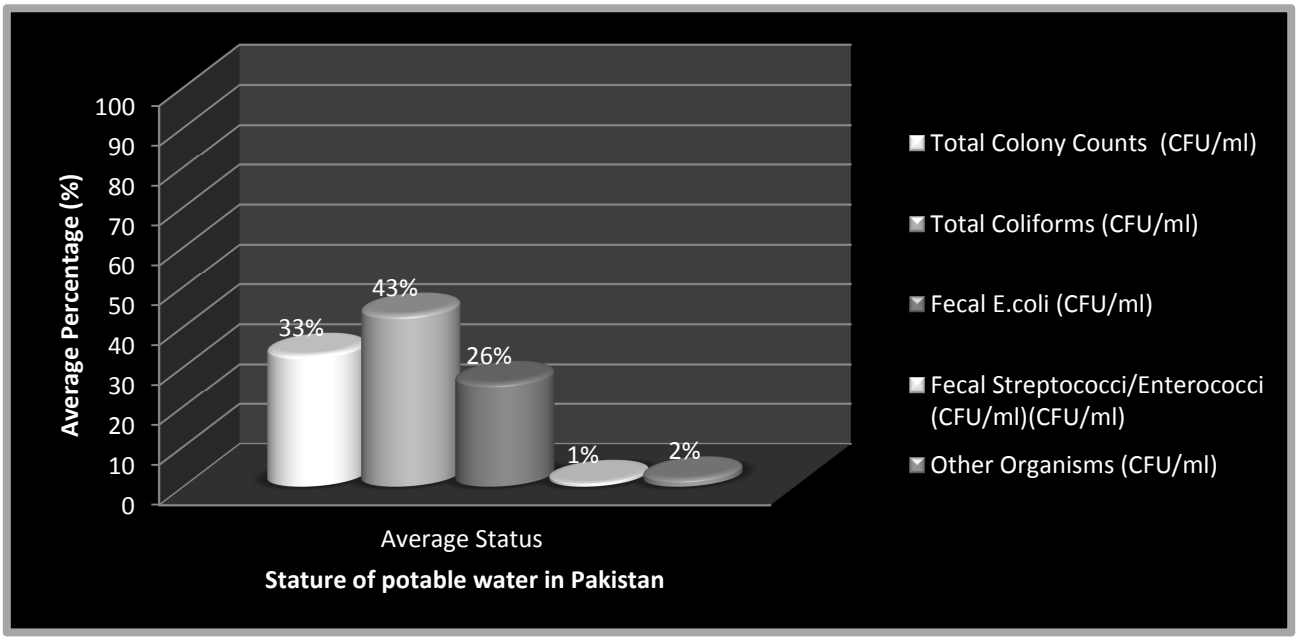
Key: (>5700) *denotes diabolical water sample that own exorbitant bacterial counts,*
(<01) *denotes veritable water sample that own few or no bacterial counts*

PROMINENCE OF WATER QUALITY IN PAKISTAN

Status of potable water quality has not changed much in these contexts. The bacteriological survey was conducted on daily consumed potable water from kaleidoscopic sources over the country. The results were then synopsized according to level of adulteration i.e. (52%) exclusively in cantonal sectors across Pakistan. From the result, we analyzed that there is no refinement in quality of water since past surveys. The current catastrophic environmental conditions and lack of advancement has upgraded the level of contamination and water borne maladies. Germane quarters of the country such as Sindh, Punjab and Khyber Pukhtoonkhuwa possess unreasonable bacterial counts which pose a life-threatening circumstance. Blustered expositions of epizootic water borne afflictions such as Dengue Shock Syndrome, Poliomyelitis, Typhoid fever, Cholera, Hepatitis A and E and assorted other cutaneous and gastric ailments are dominating. Escalating mortality and morbidity rates especially in juveniles are predominant. Bacteriologically these commonly consumed water sources are penurious and are debilitated for drinking due to revenant of torrent bacterial counts mainly fecal coliforms, pathogenic fecal *E.coli*, *Enterococci, Streptococci, Pseudomonas, Clostridium* and relatively some fungi. Bacteriological average stratum of country “Pakistan” are synopsized in (Graph 1), (Graph 2) which displays the bacteriologically one third inadmissible viaticum of water quality.



Graph 1: Graphical index epitomizing substandard potable water stature of Pakistan



Graph 2: Graphical index epitomizing average of one third abjected magnitude of potable water in Pakistan

DISCUSSIONS

According to the reports of research study conducted in 2006 – 2008 prototyped by the Health Service Academy, Ministry of Health and Government of Pakistan in collaboration to World Health Organization and UNICEF, it was evident that water quality was bacteriologically unsatisfactory and with having deplorable presence of fecal coliforms and *E.coli.* Along with this physiochemical nature of water was also accountable due to presence of higher proportions of toxic minerals and radioactive elements [7]. The quality of water was then accused to be unsound for partaking and mainspring of water borne epidemics. Water and Sanitation Extension Program (WASEP) evaluated that morbidity of diahorreal discomforts was (33%) which reciprocates in increasing rates of bairn mortalities [8]. Soaring water pollution through direct anthropogenic supremacy,

industrial and agricultural effluents require paramount centralization to improve quality of consumable water in Pakistan in response descending the graph of water borne infections [9, 10, 11].

CONCLUSION

From the research survey, we access that water quality from contradictory district regions on average had higher colony counts which according to World Health Organization is unsafe for drinking purpose. Inflated levels of fecal *E.coli, Enterococci* and coliforms in the water samples revealed that the provenances of these samples are contaminated animal manure and human excreta which are blameworthy for infestation of water borne infirmities. Therefore bona-fide water treatment plants and sewage plants must be engrafted to confront the impoverish water status of the Pakistan as according to ordinance it is cardinal right of the confederation to profit from good water quality. Natives must also be tutored to tackle situations predominantly in cataclysm by implementation of cheap disinfection sources such solar water disinfection, conventional boiling and chlorination.

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