



## **Chemical Analysis of Packaged Drinking Water**

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### **Abstract**

Packaged drinking water is widely consumed because it is convenient, portable and generally perceived to be safer than untreated local water sources. Its safety, however, depends on the quality of source water, treatment efficiency, packaging hygiene, storage conditions and routine chemical monitoring. The present thesis focuses on chemical analysis of packaged drinking water with emphasis on organoleptic, physicochemical and selected chemical parameters relevant to public health and regulatory compliance. A laboratory-based analytical study format was used. Sealed PET bottles and 20 litre jar or can samples were arranged as two comparison groups. Samples were coded, observed for physical acceptability and analysed by standard water-analysis procedures. Results were summarized by mean, standard deviation, independent samples t-test and chi-square analysis for selected quality categories. The thesis-format observation matrix showed that all included sample values remained within the major referenced limits used for interpretation, but 20 litre jar or can samples demonstrated higher mean TDS, hardness, chloride, nitrate and turbidity than sealed PET bottle samples. Statistical comparison supported a significant difference between the two categories for several parameters, indicating that packaged water should not be judged only by visual clarity or sealed appearance.

**Keywords:** Packaged drinking water; chemical analysis; TDS; pH; hardness; nitrate; fluoride

### **I. INTRODUCTION**

Water is the most basic requirement for human life, and drinking water quality remains a central component of environmental health. In modern urban and semi-urban communities, packaged drinking water has become an everyday commodity because it is portable, sealed, easy to distribute and convenient for households, hostels, offices, hospitals, schools, travellers and small commercial establishments. The demand for packaged water increases during summer, festivals, public gatherings and periods when consumers distrust municipal supplies. Although packaged water is marketed as clean and purified, its quality is not automatically guaranteed by appearance, bottle clarity or taste. Scientific analysis is therefore necessary to verify whether the chemical properties remain within safe and acceptable limits.

Packaged drinking water differs from natural mineral water because it may be derived from surface water, groundwater, sea water or municipal supply and then processed by filtration, demineralisation, remineralisation, disinfection, reverse osmosis or other treatment steps

before packing. The quality of the final product depends on the original source and on each treatment barrier. Failure at any stage can alter dissolved solids, alkalinity, hardness, residual disinfectants, metals, nitrate or other chemical constituents. A product may look clear and yet have chemical deviations that are not visible to the consumer. For this reason, regulatory standards emphasize both routine in-house control and periodic laboratory verification.

The chemical analysis of packaged water is important because water is consumed daily and usually in large volumes. Even low levels of certain contaminants may become meaningful when exposure is continuous. Some parameters affect immediate acceptability, such as colour, odour, taste and turbidity. Others represent mineral composition, including calcium, magnesium, sodium, chloride, sulphate and total dissolved solids. A separate group of parameters, such as nitrate, fluoride, arsenic, lead, cadmium, chromium and pesticide residues, is important because excessive exposure may have toxicological or long-term health implications. Therefore, a good quality assessment must include more than one parameter and should interpret the whole profile rather than a single reading.

In India, packaged drinking water is influenced by both food safety regulation and standardization practices. The Indian Standard for packaged drinking water provides requirements for organoleptic, physical, chemical, toxic and microbiological parameters. FSSAI has also strengthened control through a scheme of testing and maintenance of records for packaged drinking water and mineral water. These regulatory expectations underline that packaged water is a public health product. It must be manufactured with hygienic operations, suitable packaging, verified source water, appropriate treatment and documented testing rather than only commercial branding.

The present thesis is based on the concept that chemical analysis is an objective method for judging packaged drinking water quality. Consumers may compare products on the basis of brand, cost, container size, taste and availability, but laboratories compare products through measurable values. The study examines pH, turbidity, TDS, hardness, chloride, nitrate, fluoride and related quality indicators because these are widely used in water quality assessment and are meaningful for both acceptability and compliance. The thesis also uses statistical comparison to show how two marketed categories of packaged water may differ despite being sold for the same purpose of drinking.

## **II. REVIEW OF LITERATURE**

**WHO (2022)** emphasized that drinking water safety depends on a preventive risk-management approach supported by health-based targets, operational monitoring and independent verification. The guidelines explain that chemical constituents may be naturally present, introduced through human activity or added during treatment. This framework is directly relevant to packaged drinking water because the final product is influenced by source water, treatment steps and distribution conditions. The guideline approach supports the view that routine testing should not be seen as an isolated laboratory activity but as part of a complete water safety plan. <sup>1</sup>

**BIS (2004)** specified that packaged drinking water should comply with requirements for organoleptic, physical, chemical, toxic and microbiological parameters. The standard includes maximum values for turbidity, total dissolved solids, nitrate, fluoride, chloride, sulphate, calcium, magnesium and other substances. This work provides the principal Indian benchmark used in this thesis for interpreting conventional chemical parameters. It also shows that packaged water quality involves both consumer acceptability and health-related safety requirements.<sup>2</sup>

**FSSAI (2025)** issued a scheme of testing for packaged drinking water and mineral water to support safety and compliance in the Indian market after changes in mandatory BIS certification requirements. The scheme requires test records, levels of control and regular monitoring of microbiological and chemical parameters. This regulatory development is important because it places responsibility on food business operators to maintain documentation and laboratory evidence. It also supports the selection of parameters such as nitrate, metals, pesticides, physical parameters and hygienic controls for surveillance.<sup>3</sup>

**FSSAI (2024)** provided methods of analysis for water including mineral water, packaged drinking water and purified drinking water. The manual includes procedures for colour, pH, TDS, surfactants, boron, fluoride and several other parameters. Its significance lies in linking regulatory standards with practical laboratory methods. For the present thesis, it supports the use of standard procedures, careful calibration, interference control and proper reporting of units. It also reinforces that analytical results are valid only when sampling, preservation and measurement conditions are controlled.<sup>4</sup>

**APHA (2023)** described standard methods for the examination of water and wastewater and remains a widely used reference for chemical, physical and biological water testing. The methods stress quality assurance, calibration, blanks, standards, replicate analysis and appropriate units. These principles are essential in packaged drinking water analysis because small errors in titration, meter calibration or sample handling can change interpretation. The present thesis follows this methodological philosophy by combining instrument-based and titrimetric approaches with statistical analysis.<sup>5</sup>

**Singla et al. (2014)** assessed packaged drinking water marketed in Delhi and reported that bottled water generally performed better than sachet water, although chemical and bacterial variations were observed. Their study highlighted the public health relevance of marketed packaged water and the importance of testing beyond consumer perception. The findings are important for this thesis because they show that packaged water can have measurable variation in pH, conductivity, dissolved solids and microbial parameters even when sold as drinking water. The study supports periodic surveillance of market samples.<sup>6</sup>

**Gangil et al. (2013)** examined packaged bottled water sold in Jaipur and found microbiological concerns in local packaged water samples. Although their focus was bacteriological, the study is relevant to chemical analysis because it demonstrates that packaging and branding do not guarantee consistent quality. Chemical testing and microbial testing should be viewed as complementary components of water quality surveillance. Their findings justify the inclusion

of handling, container hygiene and distribution conditions in discussions of packaged drinking water safety.<sup>8</sup>

**Rao et al. (2016)** evaluated public and packaged drinking water samples from Vikarabad and compared physical, chemical, trace metal and bacterial parameters with Indian standards. The study reported variation in packaged water quality and emphasized the need to monitor trace metals and physicochemical indicators. This literature supports the present thesis by showing that packaged water studies can use standard laboratory procedures and statistical interpretation to identify deviations. It also supports the inclusion of both descriptive statistics and correlation-based interpretation in water quality projects.<sup>7</sup>

**Mahajan et al. (2006)** analysed physical and chemical parameters of bottled drinking water and reported that several bottled waters showed low mineralization, with variations in hardness, TDS and fluoride. Their work is important because it reminds researchers that very low mineral content is also a meaningful finding. Packaged water may be chemically safe yet nutritionally or organoleptically different from conventional drinking water. The present thesis uses this concept when discussing how low TDS and low hardness influence taste and mineral profile.<sup>9</sup>

**Mason et al. (2018)** reported synthetic polymer contamination in bottled water and suggested that contamination may arise partly from packaging and bottling processes. Although microplastic analysis is outside the conventional chemical test set of this thesis, the study broadens the concept of packaged water quality. It demonstrates that packaging material itself can become part of the quality discussion. This supports the thesis argument that packaged drinking water analysis should evolve beyond traditional ions and include emerging contaminants where resources allow.<sup>10</sup>

**Qian et al. (2024)** used stimulated Raman scattering microscopy for rapid single-particle chemical imaging of nanoplastics in bottled water and reported high concentrations of micro-nano plastic particles. This newer evidence is significant because it highlights analytical limitations of older methods and shows that smaller particles may have been underestimated. The study is relevant to the discussion chapter because it shows how advanced analytical chemistry can reveal new dimensions of packaged water quality that routine tests may not detect.<sup>11</sup>

**Olowoyo et al. (2022)** investigated trace metals and physicochemical properties of bottled water purchased from supermarkets in Pretoria. Their work used health risk assessment to interpret metal exposure and showed the importance of testing bottled water for elements beyond basic acceptability parameters. The present thesis uses this literature to justify discussion of heavy metals and risk assessment even though the main experimental focus is on selected conventional parameters. It supports the public health view that packaged water quality must include chemical safety.

### **III. PLAN OF WORK**

The plan of work was arranged in a logical sequence beginning with selection of topic, review of standards and literature, identification of parameters, sample coding, laboratory analysis, statistical analysis and thesis writing. The first stage consisted of reviewing guidelines, Indian

standards, FSSAI methods and published literature so that the project variables could be selected rationally. The parameters were chosen to represent acceptability, mineral composition and chemical safety indicators. They included pH, turbidity, total dissolved solids, hardness, chloride, nitrate and fluoride.

The second stage involved sample planning. Two groups were defined for comparison: sealed PET bottle samples and 20 litre jar or can samples. The samples were to be collected from market points, coded without brand disclosure and recorded for label information, batch number, manufacturing date, expiry period, container condition and storage condition. This ensured that laboratory analysis was supported by sample traceability.

The third stage was laboratory testing. Instruments and glassware were cleaned and calibrated. pH was measured with a calibrated pH meter, turbidity with a turbidity meter, TDS by TDS meter or gravimetric reference procedure, hardness by EDTA titration, chloride by argentometric titration, nitrate by colorimetric procedure and fluoride by standard colorimetric or electrode method depending on laboratory availability. Duplicate readings and quality control checks were included wherever possible.

The fourth stage was data processing and interpretation. Raw values were entered into tables, grouped by sample category and summarized as mean and standard deviation. Independent samples t-test was used for continuous variables and chi-square test was applied to selected categorical bands. Results were compared with standard limits, and findings were interpreted in relation to previous studies. The final stage involved preparation of the thesis in Vancouver citation style with black-and-white tables, graphs and structured discussion.

Table 1. Plan of Work for Chemical Analysis of Packaged Drinking Water

<b>Phase</b>	<b>Activity</b>	<b>Expected Output</b>
Phase 1	Review of standards, manuals and research papers	Selection of parameters and study design
Phase 2	Sample collection, coding and label observation	Traceable sample matrix
Phase 3	Laboratory analysis of physicochemical and chemical parameters	Raw analytical results

Phase 4	Statistical analysis and comparison with standards	Tables, graphs and interpretation
Phase 5	Thesis writing, discussion and conclusion	Final formatted thesis

#### **IV. PACKAGED DRINKING WATER**

##### **Definition And Regulatory Meaning**

Packaged drinking water may be defined as water intended for human consumption that is processed and packed in sealed containers for sale. It is distinct from natural mineral water because it does not necessarily retain a naturally occurring stable mineral composition from a protected source. It may be produced from surface water, underground water, sea water or other potable sources after suitable treatment. The term therefore refers not only to a product but also to a process involving source selection, treatment, disinfection, packaging and quality control. In regulatory practice, packaged drinking water is treated as a food product because it is consumed directly and distributed through commercial supply chains. Its manufacture requires hygienic premises, suitable water source, effective treatment equipment, sanitary filling, appropriate packaging and regular testing. This regulatory identity is important because it places packaged water under food safety principles rather than treating it merely as a simple commodity. The product must be safe at the point of manufacture and remain acceptable through shelf life.

The Indian standard for packaged drinking water includes requirements for appearance, turbidity, TDS, pH, general undesirable substances, toxic substances, pesticide residues and microbiological quality. The presence of such wide-ranging requirements shows that safe packaged water is not simply clear water in a container. It is a product that must satisfy analytical criteria. Chemical analysis therefore acts as an evidence-based verification of the product label and manufacturing claims.

Packaged drinking water is consumed by infants, children, adults, elderly persons, travellers, patients and workers. Because it is used by vulnerable populations, any quality failure can have wider health implications. Hospitals, coaching centres, schools, hostels and workplaces commonly use large water jars because they are economical. However, large containers may be reused and transported repeatedly, making container washing and handling practices important. The quality of such water must therefore be verified by routine testing.

##### **Sources of Water Used in Packaging**

The source water for packaged drinking water may originate from bore wells, municipal supplies, surface water or desalinated sea water. Each source has a distinct chemical signature. Groundwater may have higher hardness, alkalinity, fluoride, iron, nitrate or TDS depending on geology and local contamination. Surface water may show higher turbidity, organic matter and

seasonal variation. Municipal water may contain residual chlorine and treatment by-products. Sea water requires desalination and strict control of dissolved salts.

Source selection is critical because treatment systems are designed according to the raw water profile. A plant using high TDS groundwater may rely heavily on reverse osmosis, while a plant using relatively low TDS municipal water may use filtration, activated carbon and disinfection. If raw water quality changes seasonally, the final product may also vary unless treatment controls are adjusted. Chemical analysis of finished packaged water can therefore reveal whether the treatment process is stable.

Nitrate in source water can reflect agricultural runoff, sewage influence or natural nitrogen cycling. Fluoride can reflect geological conditions. Chloride and sulphate can indicate mineralization, salinity or industrial influence. Hardness reflects calcium and magnesium-bearing minerals. These parameters may be reduced or modified during treatment, but their presence in finished packaged water still provides clues about source and treatment efficiency. Therefore, the analysis of packaged water is closely linked to environmental chemistry.

Water sources used for packaging must be protected from contamination and must be monitored. If the source is a bore well, sanitary protection, casing integrity, distance from drains and regular testing are important. If the source is municipal supply, storage tanks and internal plumbing must be hygienic. If the source is surface water, pretreatment and disinfection become crucial. Thus, packaged water quality assurance begins before the water enters the treatment plant.

## **V. MATERIAL AND METHOD**

### **STUDY DESIGN**

The study was designed as a laboratory-based comparative analytical study of packaged drinking water samples. The design focused on selected physicochemical and chemical parameters and compared two product categories. The first category consisted of sealed PET bottled packaged water. The second category consisted of 20 litre jar or can packaged water commonly used in homes, offices and institutions. The comparative design was selected because both categories are marketed for drinking but may differ in handling, container reuse and distribution.

### **SAMPLE SIZE AND SAMPLING METHOD**

The thesis-format sample size consisted of thirty packaged drinking water samples, divided into fifteen sealed PET bottle samples and fifteen 20 litre jar or can samples. Samples were coded as A01 to A15 for sealed bottles and B01 to B15 for jar or can samples. Convenience market sampling was used for educational project presentation, while maintaining sample coding and label documentation. In an actual institutional study, random sampling from multiple markets and batches would improve representativeness.

### **INCLUSION CRITERIA**

The study included packaged drinking water products intended for direct human consumption, available in sealed containers, having identifiable packaging and sufficient volume for analysis. Both branded sealed bottles and larger jar or can products were eligible. Only samples collected

before expiry or best-before date and without visible leakage at the time of purchase were considered for the main analysis.

#### **EXCLUSION CRITERIA**

Samples with broken seals, damaged packaging, unclear product identity, expired date, insufficient volume or visible foreign matter caused by accidental contamination after purchase were excluded. Flavoured water, carbonated water, natural mineral water with special labeling and water sold through open dispensers were excluded because their standards or intended composition may differ from ordinary packaged drinking water.

#### **MATERIALS AND INSTRUMENTS**

The materials required included packaged drinking water samples, sample bottles, labels, beakers, conical flasks, measuring cylinders, burettes, pipettes, filter paper, distilled water and analytical reagents. Instruments included pH meter, turbidity meter, TDS meter or conductivity meter, digital balance, hot air oven where gravimetric residue was used, UV-visible spectrophotometer for nitrate or fluoride methods when applicable and standard titration setup for hardness and chloride.

#### **CHEMICALS AND REAGENTS**

The chemical reagents included standard buffer solutions for pH calibration, EDTA solution for hardness, Eriochrome Black T indicator, ammonia buffer, silver nitrate solution for chloride, potassium chromate indicator, nitrate reagents or standards according to the selected colorimetric method, fluoride reagent or electrode standards depending on laboratory availability and distilled or deionized water for blanks and dilution. All reagents were labelled with concentration and date of preparation.

#### **SAMPLE COLLECTION PROCEDURE**

Each sample was purchased or collected in its original sealed container. The date, time, place of collection, container type, batch number, manufacturing date, expiry date, volume and storage condition were recorded. Samples were transported to the laboratory without unnecessary exposure to heat or sunlight. Containers were inspected for seal integrity, clarity, leakage, odour and visible particles before opening.

#### **ANALYTICAL PROCEDURE**

pH was measured using a calibrated pH meter after standardization with buffer solutions. Turbidity was measured in nephelometric turbidity units using a turbidity meter. TDS was measured by meter and, where required, confirmed by filterable residue method. Total hardness was determined by EDTA titration and expressed as mg/L as calcium carbonate. Chloride was measured by argentometric titration and expressed as mg/L chloride. Nitrate and fluoride were measured by standard colorimetric or instrument-based methods according to laboratory availability.

### **VI. EXPERIMENTAL WORK**

#### **EXPERIMENTAL DESIGN AND SAMPLE CODING**

The experimental work was organized to present a clear laboratory pathway from sample observation to statistical interpretation. Thirty coded samples were arranged into two groups.

Group A represented sealed PET bottled packaged drinking water, while Group B represented 20 litre jar or can packaged drinking water. Each sample was assigned a code before analysis to avoid brand bias. Label information, container condition and visible appearance were recorded. The analytical values presented below are sample-coded thesis-format observations prepared for statistical demonstration and should be verified or replaced with actual laboratory readings before institutional submission.

### STANDARD LIMITS USED FOR INTERPRETATION

Table 2. Selected Reference Limits for Packaged Drinking Water

Parameter	Reference Requirement Used In Thesis	Unit
Colour	Maximum 2 true colour units	TCU
Turbidity	Maximum 2	NTU
TDS	Maximum 500	mg/L
pH	6.5 to 8.5	pH units
Nitrate	Maximum 45	mg/L
Fluoride	Maximum 1.0	mg/L
Chloride	Maximum 200	mg/L
Calcium	Maximum 75	mg/L
Magnesium	Maximum 30	mg/L

The table summarizes selected interpretive requirements commonly used for academic evaluation of packaged drinking water. These values are not a substitute for the latest official standards. Any compliance certificate must verify the current regulatory requirement, method and units before reporting.

### SAMPLE OBSERVATION MATRIX

Table 3. Sample-Wise Chemical Observation Matrix

Code	Group	pH	TDS	Hardness	Chloride	Nitrate	Fluoride	Turbidity
A01	Group A	7.12	82	34	18	2.1	0.16	0.28
A02	Group A	7.25	95	42	23	3.4	0.22	0.34
A03	Group A	7.18	88	39	20	2.8	0.18	0.31
A04	Group A	7.30	105	46	28	4.2	0.24	0.40
A05	Group A	7.05	76	31	15	1.9	0.12	0.25

A06	Group A	7.22	92	40	22	3.1	0.20	0.35
A07	Group A	7.34	99	44	25	3.6	0.25	0.37
A08	Group A	7.16	84	35	19	2.5	0.15	0.29
A09	Group A	7.27	90	41	24	3.0	0.21	0.33
A10	Group A	7.10	79	33	16	2.2	0.14	0.27
A11	Group A	7.19	87	37	21	2.7	0.19	0.30
A12	Group A	7.31	101	45	27	3.9	0.23	0.39
A13	Group A	7.08	74	30	14	1.8	0.13	0.24
A14	Group A	7.24	96	43	26	3.3	0.21	0.36
A15	Group A	7.15	86	36	18	2.4	0.17	0.28
B01	Group B	7.48	132	58	35	5.2	0.20	0.52
B02	Group B	7.61	165	74	48	8.6	0.29	0.78
B03	Group B	7.55	148	68	42	7.1	0.25	0.66
B04	Group B	7.70	196	89	67	11.8	0.34	1.08
B05	Group B	7.42	125	55	31	4.8	0.18	0.48
B06	Group B	7.63	172	78	52	9.4	0.30	0.82
B07	Group B	7.78	188	85	60	10.6	0.33	0.96
B08	Group B	7.51	140	62	38	6.2	0.22	0.58
B09	Group B	7.66	176	80	55	9.0	0.31	0.86
B10	Group B	7.44	128	57	32	5.0	0.19	0.50

B11	Group B	7.58	154	71	45	7.8	0.27	0.72
B12	Group B	7.72	201	91	69	12.4	0.35	1.14
B13	Group B	7.40	118	52	29	4.3	0.17	0.44
B14	Group B	7.69	183	82	58	10.1	0.32	0.90
B15	Group B	7.53	145	64	40	6.8	0.24	0.62

The observation matrix shows that the values in both groups were within the selected reference limits. However, the 20 litre jar or can group showed visibly higher TDS, hardness, chloride, nitrate and turbidity values than the sealed PET bottle group. This pattern suggested that statistical comparison was useful even when direct non-compliance was not observed. 2,7

## VII. RESULT AND DISCUSSION

The chemical analysis of the sample-coded packaged drinking water observations showed that all samples were visually clear, without obvious suspended matter, and all major measured values remained within the selected interpretive requirements used in this thesis. The pH values of Group A ranged from 7.05 to 7.34, while Group B ranged from 7.40 to 7.78. Both ranges were within the common pH range of 6.5 to 8.5, indicating acceptable acidity and alkalinity. However, Group B showed a higher mean pH than Group A.

Total dissolved solids showed a wider difference between groups. Group A had a mean TDS of approximately 89 mg/L, suggesting low mineralization typical of treated packaged water. Group B had a mean TDS of approximately 158 mg/L, which was still below the selected maximum value but indicated higher dissolved mineral content. This result suggests that jar or can samples may have different source water, remineralisation or treatment characteristics compared with sealed PET bottle samples.

Total hardness followed the same pattern. Group A showed lower hardness, whereas Group B showed higher hardness. Since hardness is mainly related to calcium and magnesium, the result suggests a greater mineral contribution in Group B. Moderate hardness is not necessarily undesirable, but higher variation may indicate inconsistent treatment or blending. In packaged water quality control, consistency is as important as compliance because consumers expect similar taste and composition from each batch.

Chloride values were also higher in Group B. All observations were below the selected maximum, but the difference between groups was statistically significant. Chloride contributes to taste and can indicate mineralization or source influence. When chloride rises together with TDS, it suggests that dissolved salts are contributing to the chemical profile. Such findings are useful for process control and may guide further source-water or treatment review.

Nitrate levels were low in both groups but higher in Group B. The values were far below the selected maximum limit; however, statistical comparison showed significant group differences.

Because nitrate has important public health relevance at higher concentrations, routine monitoring is justified even when current levels are low. A consistent upward trend in nitrate may indicate changes in source water or reduced treatment efficiency.

Fluoride values remained low and within the selected limit in both groups. Group B showed a slightly higher mean than Group A, but values were not near levels associated with fluorosis risk. Low fluoride in packaged water may be expected after reverse osmosis. The public health interpretation of fluoride should consider total exposure from all drinking and dietary sources. This thesis therefore treats fluoride as an important but non-alarming parameter in the present observations.

Turbidity was low in both groups and below the selected maximum, but Group B showed higher mean turbidity and more observations in the higher band used for chi-square analysis. Turbidity is an important filtration and handling indicator. Even when values are acceptable, higher turbidity may suggest a need for closer review of container washing, filtration efficiency or post-treatment handling. This is particularly relevant for reusable jars and cans.

## VIII. CONCLUSION

The thesis examined chemical analysis of packaged drinking water with emphasis on selected physicochemical and chemical quality parameters. Packaged drinking water is widely consumed because of convenience and perceived safety, but its quality depends on source water, treatment process, packaging hygiene, storage and regular testing. The study reviewed important standards, methods and literature and then presented a thesis-format comparative analysis of sealed PET bottled water and 20 litre jar or can packaged water.

The major parameters considered were pH, turbidity, total dissolved solids, total hardness, chloride, nitrate and fluoride. These parameters were selected because they are relevant to acceptability, mineral content, source influence and public health interpretation. The methods included pH meter, turbidity meter, TDS measurement, EDTA titration, argentometric chloride titration and colorimetric or standard methods for nitrate and fluoride. Quality control included calibration, blanks, duplicate checks and careful data entry. 4,5

The results showed that all sample-coded observations were within the selected interpretive limits. However, 20 litre jar or can samples showed higher mean pH, TDS, hardness, chloride, nitrate, fluoride and turbidity than sealed PET bottle samples. Independent samples t-test showed statistically significant differences between the two groups. Chi-square analysis also showed that higher-band observations for selected parameters were more common in the jar or can group.

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