Physico-Chemical Analysis of Packaged Drinking Water - A Comparative Study

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ABSTRACT

About thirty years back there was no existence of packaged drinking water but today packaged drinking water is the essential part of the market because of its stable growth and shelf life both globally and locally. Packaged Drinking water is any bottled water which is obtained from natural spring, well water or municipal supplies to this water chemicals and minerals may or may not be added, this is then sold for business or domestic uses all across the globe in unhampered, sealed, and clean containers. This water is subjected to many local and global standards which must be followed for safe drinking purposes. In this research a comparative analysis was done to access the quality level of the packaged drinking water available in the market.

Keywords: Packaged drinking water, Physico chemical analysis, Comparative study.

Introduction:
The market forecast for 2013 predicted $94.2 billion value of this industry which has an increase of 41% since 2007. This reveals an ever increasing demands for numerous consumers all across the globe. [1]

The journey of bottled water industry began in 19th century when the Ricker family of Maine bottled and sold the water. This small initiative grew and led to this rise of this industry. The medicinal properties of spring water which was initially bottled without any knowledge about the minerals it offered soon came into notice; this became Poland Springs Water Company.

Keeping in view the success of the Poland Company many new companies came into existence in 1905 like Ozarka Spring Water Company of Eureka Springs. Since then there was no looking back for this industry. Now there are hundreds of different brands of Packaged Drinking Water available all across the globe. Ozarka and Poland are both owned by Nestle now and are a part of their reputed 75 different water brands [2]

The real milestone for this industry was when the company named Vittel launched the first plastic bottled water in the world in 1968. This revolutionised the way people used to consume bottled water in the world. France, Germany and Europe became the most stable players in the market [3]

Bottled water became slowly more acceptable because tap water in certain countries was either not found or not potable. These were the main reasons why bottled water came into being.

Indian bottled drinking water industry is driven by the events of unpredicted water shortage and health consciousness that has started to develop in the people.

The market is at 1,000 Crore and has a growth of 40%. It is expected to reach 4,000 to 5,000 Crore that is an increase of 33% in the market. Today round about 200 different brands of bottled water are present and among them 80% are local in nature. Indian is 10th largest bottle manufacturer in the world.

<table>
<thead>
<tr>
<th>Year</th>
<th>Water Produced (Million cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>2.3</td>
</tr>
<tr>
<td>1992</td>
<td>2.7</td>
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<tr>
<td>1994</td>
<td>3.6</td>
</tr>
<tr>
<td>1996</td>
<td>4.8</td>
</tr>
<tr>
<td>1998</td>
<td>15.9</td>
</tr>
<tr>
<td>2000</td>
<td>36</td>
</tr>
<tr>
<td>2002</td>
<td>45.5</td>
</tr>
<tr>
<td>2004</td>
<td>67.4</td>
</tr>
<tr>
<td>2006</td>
<td>98</td>
</tr>
<tr>
<td>2008</td>
<td>112.7</td>
</tr>
</tbody>
</table>
The market of bottled water is dominated by certain players from past few years since it is very competitive. The main marketing competition among the players is that of packaging and attractive labelling which gathers them huge consumer base. The main market share is that of Bisleri International which is 40%, next comes Kinley (around 25%) and then Aquafina (10%) rest is followed by the local market players in the market (20-25%) [10]. One of the great ways developed by Parle Agro and PepsiCo is that of capacity enhancement which the only way of surviving the competition is.

Water Regulation in India: The packaged drinking water is solely managed by the Bureau of Indian standards (BIS) in association with the Health Ministry. The rules are formulated by PFA. The main objective was to come up with the collaborated act and legal requirements for allowable limits in the packaged drinking water. [13]

For packaged drinking water BIS-14543 and for natural mineral water BIS-13428 is to be followed. The packaging and labelling requirements are all covered in the same. It is mandatory to have the BIS mark on the bottled water and follow the requirements set by the standard agency for quality water intake of the consumers. The packaged drinking water industry to be licensed and setup is all mentioned in the 14543 standard and the audit for the same is done as per the required standards.

Materials and Methods: This research deals with the comparative Physico chemical analysis of the Bottled water available in the state of Jammu and Kashmir (Kashmir division). Following are the methods and techniques adopted to have an exhaustive coverage of this topic. The research technique for the wet lab work is as follows:

Objectives of the Study: Research design for Wet lab work
1. To study the Physico-chemical analysis of the packaged drinking water.
2. To perform a comparative analysis of the top ten leading bottled water companies of the valley as per consumer preference.
3. To perform a comparative analysis of the source water of the two packaged drinking water companies in the range of 100 meters in the light of BIS 10500 as a set standard for licensing.
4. To evaluate the samples as per FSSA 2011 Regulation (Packaging and labelling) and BIS 15410 for packaging and labelling requirements for the sample and interpret the results for the same
5. To interpret the results in the light of BIS 14543 (PDW), BIS 15410 (P&L), BIS 13428(NMW) and BIS 10500 (Source water).

Limitations of the Study
1. Performance of the limited quality analysis tests.
2. Evaluation of only those parameters that are commonly found in the source water of the area.
3. Availability of the limited source water samples

Selection of samples and Geographical area of study
The samples were collected on pure consumer preference of the bottled water. This consumer preference was analysed by the consumer buying behaviour in the retail and wholesale markets by conducting face to face discussions with the retails and wholesale owners. The most preferred top ten brands were selected for analysis. The location was restricted to Srinagar, Jammu and Kashmir.

Research Framework: The entire wet lab work (analysis and comparative testing) was done in the light of the BIS 14543 manual. The methods and procedures used in the analysis and testing were as per Annexure 11 of the manual and the results were compared with the Annexure 10 of the BIS manual. Keeping in view the Food Safety and Standards act 2011 regulation for packaging and labelling, the same samples were subjected to detailed study for the parameters as per the regulation. The samples were also studied Under BIS 15410 (standard for Packaging and labelling).

Data editing and Statistical Tools: Simple measurement by central tendency was done and tools used were:
Percentage calculation: this is used to give a certain percent value for a data and represents the data in a better form.

Mean is the main or the central value of the probability distribution.

Findings and Discussions: This research brings into limelight some serious areas of concern regarding the packaged drinking water quality available in the market and the consumer acceptability of the same. It also focuses on the packaging and labelling rules which are to be followed by the multiple companies to keep their product up to the mark.

Wet Lab work: Each of the samples was tested for Ph, hardness, colour, TDS, alkalinity, chloride, calcium, magnesium, Odour and taste. Apart from these qualitative and quantitative parameters the samples were also tested for many packaging and labelling requirements that are to be there for the certifications. Two of the source water samples were also tested for the same parameters.

The key findings of the research are discussed below with interpretation as per BIS:

Key findings:

1. **Higher Magnesium Content In 41 % Of The Samples:** It was found that 41 % of the samples had a higher magnesium content as prescribed by BIS 14543 That is ought to be 30 ppm max in packaged drinking water and as per BIS 13428 50 ppm max for natural drinking water. Also as per BIS 10500 the max magnesium content for source water to be selected as per licensing requirement is 30 ppm. These set standards are found to be violated in the 41 % of the samples collected.

High magnesium content in the body may lead to health issues like; People with kidney disease are not able to expel magnesium from body therefore can cause, hypertension, confusion, muscle weakness, and coma. It is therefore necessary to expel the undesired magnesium content from the body to live a healthy life. [16].

2. **33% of the samples have not agreeable taste:** It was found after meticulous sensory evaluation that 33% of the samples had a poor taste not as per the required standards fixed for the bottled water and source water.

Taste is one of the most important factor for the bottled water to improve its consumer acceptability. If taste is not up to the mark the product may easily be rejected on the market shelves. Taste of the product is determined by the hardness it has, the Ph it contains, the source from which it is taken and the rest of the minerals it posses.

3. **1% of the samples had acidic Ph:** Results revealed that a sample was also found to be acidic and in the decreasing Ph condition when tested. The Ph for bottled water is supposed to be 6.5-8.5 on a regular basis the sample was found to have a decreasing (un stable) Ph of 6.01 and decreasing.

This acidic water can lead to leaching in the pipes and leaching atoms and ions from filters and other fittings causing the mineral content of the water to increase because of that the hardness of water may increase causing foul odour and poor taste.

4. **40% of the sample had a wrong product description and deceptive source details.** It was found that 40 % of the samples collected had a poor description that was mainly deceptive towards consumers as per FSSAI 2011 regulation for packaging and labelling. These false and misleading claims, mislead the consumer towards the real source of water that is ground water. As per the food safety and standard regulation 2011 packaging and labelling regulation 2.2.1.3 i.e. *Pre packaged food shall not be described or presented on any label or in any labelling manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect.* Those violating it are subjected to a penalty of three lakh as per section 52 of FSSA 2006

5. **80% of the sample had FSSAI logo in a wrong format:** As per food safety and standards act (packaging and labelling) regulation 2011 Reg. 2.2.1.7 the primary display panel has to have the FSSAI Logo in the following format:
Almost 80% of the samples collected had the logo in the wrong format.

### WET LAB COMPLETE DETAILS

#### Fig 1: Fssai licence format

#### Fig 2: Physico chemical analysis of Sample details

<table>
<thead>
<tr>
<th>Day 2 (After opening the seal)</th>
<th>Sample A</th>
<th>Sample B</th>
<th>Sample C</th>
<th>Sample D</th>
<th>Sample E</th>
<th>Sample F</th>
<th>Sample G</th>
<th>Sample H</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.80</td>
<td>6.83</td>
<td>6.81</td>
<td>6.84</td>
<td>6.82</td>
<td>6.85</td>
<td>6.81</td>
<td>6.84</td>
</tr>
<tr>
<td>TDS</td>
<td>59</td>
<td>59</td>
<td>58</td>
<td>57</td>
<td>58</td>
<td>56</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>Agreeable</td>
<td>Agreeable</td>
<td>Agreeable</td>
<td>Agreeable</td>
<td>Agreeable</td>
<td>Agreeable</td>
<td>Agreeable</td>
<td>Agreeable</td>
</tr>
<tr>
<td>Magnesium</td>
<td>15.82</td>
<td>15.74</td>
<td>15.71</td>
<td>15.68</td>
<td>15.70</td>
<td>15.77</td>
<td>15.74</td>
<td>15.76</td>
</tr>
<tr>
<td>Chloride</td>
<td>24.12</td>
<td>24.04</td>
<td>24.01</td>
<td>23.98</td>
<td>24.00</td>
<td>24.07</td>
<td>24.04</td>
<td>24.06</td>
</tr>
<tr>
<td>Average</td>
<td>6.35 Clear</td>
<td>6.10 Clear</td>
<td>6.35 Clear</td>
<td>6.10 Clear</td>
<td>6.35 Clear</td>
<td>6.10 Clear</td>
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<td>TDS</td>
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<td>6.10 Clear</td>
<td>6.35 Clear</td>
<td>6.10 Clear</td>
</tr>
</tbody>
</table>

**Note:** The data above represents the physicochemical attributes of different samples collected from various locations.
Fig 3: Labelling and packaging Requirements of Sample-comparative details

Fig 3: Source water comparison details

Conclusions: After the detailed analysis of the available brands, following points are recommended:

- It must be noted that the calcium and magnesium level are not generally kept under limits in a lot of samples. High magnesium water can lead to a lot of health issues pertaining to hypertension, confusion, muscle weakness, and coma. For kidney malfunction patients it is hard to expel magnesium from the body of the patients. Therefore care must be taken that no very hard water is packed in bottles to avoid any complaints regarding public health.

- In majority of the samples claim of water from a different source was made it must be made mandatory that that the original source of water is mentioned so that the trust deficient in the consumers regarding the water source is erased and more consumers are able to enjoy the bottle water convenience. The local food safety authorities must act stern as per FSSA 2006 on the companies so that it sets a precedent for others claiming the same.

- Once the water hardness is brought under control it is responsible for the better taste of the companies in the market thus providing a good quality water to consumers who mainly select the water brand as per its sensory attributes. Bottled water that has no consistent mineral level changes its taste and odour with respect to time which is generally not acceptable for bottled water which may be stored with a broken seal for few days.

- During this research it was found that a lot of companies don't adhere to the proper licensing format of the FSSAI. It must be made mandatory by the local food safety agencies that the companies are made aware about the same so that the consumers can differentiate among the original license holders and the fake licences.

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Be a yardstick of quality. Some people aren't used to an environment where excellence is expected.

~ Steve Jobs