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Professional paper

QUALITY OF DRINKING WATER IN PLASTIC AND GLASS PACKAGING

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Abstract

In recent decades, the demand for the consumption of bottled drinking water has been increasing. Drinking water is an irreplaceable food product in human nutrition, therefore, in addition to processing, permanent quality control is also required. The object of the study in this paper was the analysis of several quality parameters in two types of bottled water in glass and plastic (PET). Sampling was carried out in the market of the city of Tetovo. The samples were analyzed for qualitative parameters: sensory (color, aroma, taste), physical and chemical (pH, turbidity and electrical conductivity). The results obtained in the analyzed samples showed that they are identical to those declared on the packaging label, although the water was from the same source, there were differences in the results for the analyzed parameters, but they were minimal. Sensory parameters as in the sample in plastic and glass packaging, the color was characteristic for drinking water without foreign color, the aroma without odor and without foreign taste, the pH level was almost identical between the analyzed samples with very small deviations. Based on the electrical conductivity and turbidity in the analyzed water samples, the water packaged in glass had lower values and better quality results.

Keywords: water, color, aroma, taste, pH, turbidity, electrical conductivity.

1. Introduction

Water is one of the most essential elements for health. Without it, we cannot survive. Studies show that a person cannot survive 3 days without water because the body will waste away and die. Most of the organs in your body will fail without it. Therefore, drinking water is good for everything in the human body. Water makes up over half of the body weight. Water suitable for drinking by humans is called potable water. Water that is not suitable for drinking but is not dangerous to humans is called safe water. Water in its pure state is a tasteless and odorless liquid and also has no color. It is essential for all forms of life. It is possible to drink a lot of water, but it is very difficult to do so. The total amount of water on earth is estimated to be 1.49 x 109 km^3, of which approximately 97% is seawater and the remaining 2.4% is freshwater that can be used for drinking (Prendi K, 2016). The most common sensory and physical characteristics of water are color, odor, temperature, taste, and turbidity, while the microbiological components of water are living organisms including bacteria (e.g. Escherichia coli), viruses, protozoa (e.g. cryptonposidious), phytoplankton (i.e. microscopic algae), zooplankton (i.e. small animals), insects, plants, and fish (Li, Y & Migliaccio, K., 2011). Water consumption plays an extremely important role in the functioning of vital organs. Management of all water resources will need to be improved to ensure their quality and safety (Gilbert F. Houngbo 2021). Although water doesn't expire, the plastic bottle it comes in does, and will eventually start to leach chemicals into the water. If you've ever left a glass of water out on the counter overnight and taken a sip

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the next morning, you've probably noticed that it tasted a little strange. The taste of the water changes because it's been exposed to air, making it a little more acidic and filled with dust and germs. Water is a simple chemical compound, the molecule of which consists of one oxygen atom and two hydrogen atoms. It is a colorless, tasteless and odorless liquid. The quality of water depends on its physical, biological, radiological and chemical properties. The physical properties of water are: temperature, turbidity, color, odor and taste of water and substances suspended in water, conductivity, transparency. The biological properties of water depend on the presence of various microorganisms. The radiological properties of water depend on the radioactive isotopes of light elements such as hydrogen, oxygen, potassium, sodium and other elements. The chemical properties of water depend on the type and amount of mineral substances dissolved in water (Mayer, 1993). Water should be colorless, odorless, and have a refreshing taste. All of these properties are closely related to its chemical composition, while its refreshing properties depend on its temperature. Thus, magnesium salts, if present in high quantities, give water a bitter taste, sodium salts a salty taste, iron salts an unpleasant taste, etc. Turbid water is considered polluted water and is never preferred for use as drinking water (G. E. Cordy, 2001). Water is not actually colorless, nor is pure water colorless, but it has a slight blue tint, best seen when looking through a long column of water, the blueness of water comes from water molecules absorbing the red end of the visible light spectrum. To be even more specific, the absorption of light in water is due to the way the atoms vibrate and absorb different wavelengths of light (H. A. Swenson, H. L. Baldwin 1965). Large amounts of gaseous substances can be dissolved in water. Among these, carbon dioxide and oxygen are the most important. Carbon dioxide dissolves readily in water, reaching concentrations of 2000ppm (by volume) at 25°C and 5000ppm at 0°C. The carbon dioxide content in water plays an important role in regulating its pH, but the concentration of alkaline ions also influences it, since the latter condition, more or less, the alkalinity of the water. The amount of dissolved oxygen in water decreases with increasing temperature (Peja.N, 2003). Depending on the type of substances dissolved in the water, these waters are divided into brackish (from the presence of NaCl), bitter (from the presence of magnesium) and acidic (from the presence of CO2). (Lajci.A & Kalaj.V, 1998). Temperature is a very important parameter for water, which gives it flavor. Drinking water with a temperature of (7 – 12) °C is quite refreshing and pleasant. The rate of chemical and biological reactions increases with increasing temperature. The reaction rate is usually assumed to double for a 10 °C increase in temperature (Shah.Ch.RR, 2017).

2. Materials and Methods

The research was based on taking samples of water packaged in plastic W_1 and glass W_2 containers. After taking the same samples, they were subjected to sensory, physical and chemical analyses which were carried out in the Food Technology Laboratory at the Faculty of Food Technology and Nutrition, University of Tetova.

Figure1. Determination of pH in sample W_1 and W_2

Figure2. Determination of Electrical conductivity in sample W_1 and W_2

Figure3. Determination of Turbidity in sample W_1 and W_2

3. Results and Discussion

3.1 Sensory analysis results:

Table 1. Sensory results in sample W_1

Parameters	**D_1**	**D_2**	**D_3**	**D_4**
Color (1-5)	4	4	5	4
Taste (1-5)	5	4	5	5
Aroma (1-5)	4	5	4	4
Total Points	**13**	**13**	**14**	**13**

The results obtained by the tasters in the sample W_1 are: taster D_1 evaluates the color with 4 points, the taste with 5 points, the aroma with 4 points. From taster D_2, sample W_1 for sensory parameters was evaluated with points: color 4, taste 4, aroma 5. D3 taster evaluates the color with 5 points, the taste with 5 points, the aroma with 4 points. While the D_4 taster evaluates the color with 4 points, the taste with 5 points, the aroma with 4 points. Based on the evaluations of the tasters and the points obtained, sample W_1 results with high quality, but there were differences between the evaluators.

Table 2. Sensory results in sample W_2

Parameters	**D_1**	**D_2**	**D_3**	**D_4**
Color (1-5)	4	4	5	4
Taste (1-5)	4	5	4	5
Aroma (1-5)	4	4	4	5
Total Points	**12**	**13**	**13**	**14**

The results obtained by the tasters in the sample W_2 are: taster D_1 evaluates the color with 4 points, the taste with 4 points, the aroma with 4 points. From taster D_2, sample W_2 for sensory parameters was evaluated with points: color 4, taste 5 and aroma 4 points. D_3 taster evaluates the color with 5 points, the taste with 4 points, the aroma with 4 points. While taster D_4 evaluates the color with 4 points, the taste with 5 points, the aroma with 5 points. Based on the evaluations of the tasters and the points obtained sample W_2 results with poor quality from the sensory aspect also there were differences between the evaluators.

3.2 Results of physical and chemical analyses

Table 3. Physical and chemical results in sample W_1, W_2

Parameters	**W_1**	**W_2**
pH	8.20±0.1	8.00±0.1
Electrical conductivity (mS/cm)	241±0.1	107.1±0.1
Total hardness (dH°)	4.4 ±0.01	4.0 ±0.01
Turbidity (NTU)	0.185±0.01	0.101±0.01

The results obtained in Table 3, the pH scale resulted with an average value from the three measurements carried out 8.20±0.1 in sample W_1 while in sample W_2 with an average value of 8.00±0.1. The electrical conductivity in the analyzed water sample resulted with a value of 241mS/cm ±0.1 in sample W_1 and with a lower average value of 107.1mS/cm ±0.1 in sample W_2. The total hardness with the highest average value resulted in sample W1 4.4 ±0.01 while in sample W2 the value was lower 4.0 ±0.01. Turbidity resulted from the three measurements with a minimum average value of 0.185±0.01 NTU in sample W_1 while 0.101±0.01 NTU in sample W_2. The results obtained were within the characteristic limits and declared on the packaging for the analyzed samples and with minimal differences.

Conclusions

For the analyzed parameters and the obtained results, we can conclude that the samples analyzed from the sensory, physical and chemical aspects resulted as follows:

- Sensory parameters in both sample W_1 and W_2 resulted: characteristic color for drinking water foreign color, odorless and tasteless;
- The pH scale resulted with an average value from three measurements of 8.20±0.1 in sample W_1 while with a lower average value of 8.20±0.1 in sample W_2;
- Electrical conductivity in the analyzed water samples resulted with a value of 241mS/cm ±0.1 in sample W_1 while in sample W_2 the value was lower 107.1±0.1;
- The total hardness with the highest average value resulted in sample W1 4.4 ±0.01 while in sample W2 the value was lower 4.0 ±0.01.
- Turbidity resulted from three measurements with an average value in sample W_1 of 0.175±0.01NTU while in sample W_2 the turbidity value resulted in 0.101±0.01NTU.

The results obtained for the analyzed parameters resulted within the characteristic limits and declared on the packaging for the analyzed samples.

As a final conclusion and recommendation, we can say that the water samples for analysis, although they were taken randomly in plastic and glass packaging, no significant changes were observed but they were minimal, based on the declared label, the results were within the limits foreseen by the regulations in force, so we can conclude and recommend that the water sample for the analyzed parameters meets the quality requirements and can be consumed as quality water.

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