Original Research Article

Comparing the Label and Real Content of the Local Bottled Drinking Water ManufacturedinBenghaziwithLibyanSpecificationsforLabelingPrepackagedFoods and Bottled Drinking Water

Abstract

For consumers, the composition of the water is indicated on a label attached to the water bottle. The main objective of this study was to evaluate the labeling of locally bottled drinking water bottles with the Libyan requirements for food and water labels. Physical and basic inorganic parameters were assessed for six randomly selected samples from Benghazi, Libya. The results confirmed that the specific analysis complies with the water standards indicated on the bottle labels,provingthereliabilityofthelabelswithinthestandardsbutthevaluesonthewaterbottles still differed from the actual valuesdetected in the laboratory. Only one sample (F) recorda high valueof potassium thanwhatisallowedaccordingtotheLibyanstandardsfordrinkingwater, as it recorded 14ppm. In contrast, the upper limit allowed was 12 ppm. Bottled water quality control has become necessary to have correct information on the label to inform consumers reliably and ensure human health.

Keywords: LabelContent,bottleddrinking,specifications.

INTRODUCTION

The use of bottled water has spread. The bottled water companies have already succeeded in attracting a large audience of consumers. (1, 2) About standard specifications, a specification is an approved document used for the application of requirements, characteristics, and types for a particular product or a certain method. Approved bodies issue it. Bottled water in Libya is widely consumed, preferably over tap water, and drinking water must meet standards to be healthy for human use. If the drinking water has impurities, such as physical, chemical, or microbialsubstances,anddoes not meet the standards, it will harm human life. According to the epidemiological study, water chemical impuritiescancausecardiovasculardiseases, venereal diseases, cancer, and even death.Manychemicalelementimpuritiesare present in drinking water, such as chlorine (CI), sulfate (SO4), copper (Cu), cadmium (Cd), chromium (Cr), lead (Pb), and nickel (Ni). These elements are essential to the human body. It should be present in drinking water but within the standard limit. If they exceed the limit, the water will harm human health and cause the above diseases. In addition to this, microbial contamination in drinking water can cause some severe diseases such as hepatitis, typhoid, cholera, etc. There are some physical properties of water, such as pH, TDS, and Turbidity; if these properties disobey the standards, it will harm human health.Bottled drinking water means bottled, bottled, and non-bottled drinking water. (3, 4) It is sold as "spring water" or natural mineral water.Itcancomefromvarious sources, includingmunicipalsupplies,andmustmeet internationally approved drinking water requirements.

Thebottletermmeansthatone-time-use plastic containers will be crushed after use. Labeling is an integral part of product marketing. Labeling is essential as it helps get the customer's attention, can be combined with packaging, and can be used by marketers to encourage potential buyers to buy the product. Packaging is also used for convenience and information transmission, as it is an international health requirement; otherwise, the product violates the standards. Libyan standards are concerned with the requirements that must be fulfilled in the labeling data of food packages. There are general requirements for any food product and mandatory requirements that must be written on the packages of all kinds. Particular illustrative data for bottled water will be discussed in detail in

this research. The present study aims to compare the real and labeled content of a number of Libyan bottled water brands and to compare the data label mentioned on the bottled water packages with Libyan specifications. Labeling of Prepackaged Foods and Bottled Drinking Water. (5-7)

Methods and Materials:

The study focused on Benghazi overlooking the Mediterranean Sea in the northeastern part of Libya, whose administrative borders start from the Sidi Khalifa area to theAl-Halis area, with an area of 89,191 km. The study was conducted on six different brands of locally bottled drinking water; the samples were selected randomly—the names of the brands not mentioned in the paper and symbolized by the symbols (A-B-C-D-E-F).

Sample Analysis:

All samples were analyzed to compare the results to what was written on the labeling. pH measurements were performed with a pH meter, and total dissolved solids (TDS) concentrations were measured using a TDS meter. The concentrations of cations were measured: sodium (Na +) andpotassium(K+).Theconcentrationsofanions,suchaschloride(Cl-), fluoride(F-),sulfates (SO4 2-), and nitrate (NO3-), were measured by ion chromatography. All measured values are referred to as "true content," and concentrations are expressed in milligrams /l (ppm).

STATISTICS:

Results were expressed as mean ± standard deviation (SD). Statistical analysis was performed by using SPSS software. A descriptive statistical analysis was carried out to compare bottled water sample parameters between real content and label content. Thenormaldistributiontestand WilcoxonSignedRanksTestcomparisonswereperformed.An ap-value below 0.05 was considered statistically significant.

RESULTS:

The accuracy of bottled drinking water label content:

Table(1) shows the general requirements provided by the Libyan specifications for prepackaged labeling foods and compares them with the locally made water labels that were randomly selected from the shops of the city of Benghazi.

General Requirements (Prepackaged Labeling Foods)	A	B	C	D	E	F

Packagedfoodmustcontainlabelinformation.	√	√	√	√	√	√
Datamustbewrittenin Arabic.	√	√	√	√	√	√
Thedatashouldbewritteninadifferentcolor Then, thebackgroundcolor.	√	√	√	√	√	√
Thedatashouldbeclear,irremovable,andeasyto readbytheconsumer.	√	√	√	X	X	√
Theouterpackageshouldbetransparentor, if otherwise, shouldwrite allrequireddataoutside.	√	√	√	√	√	√
Do not use names, symbols, tags, or images that are prohibited or prohibited by law.	√	√	√	√	√	√

Table (1): Comparing the general requirements according to Libyan specifications for prepackaged labeling foods with label content of the local bottled drinking water manufactured in Benghazi, Libya

Based on what is specified in the Libyan specifications for bottled drinking water, Table (2) shows theproductingredientlistforthebasicinorganicingredients,whichshouldbewrittenontheouter packaging of bottled water in a clear font**.**

Table(2): Comparisonofthemetadataofthelocallybottleddrinkingwatersampleswith the requirements of the Libyan Standard Specification for bottled water

SpecificRequirements (Libyan specification)	**A**	**B**	**C**	**D**	**E**	**F**
Productnameandwatersource location.	√	√	√	√	√	√
Licensenumberandissuingauthority.	X	√	X	X	X	X
Manufacturer'snameand address.	√	√	√	√	√	√
Packagevolumeinliters.	√	√	√	√	√	√
Productionandexpirydateinmonth, year, and Inanon-token way.	√	√	√	√	√	√
Writethetypeofmaterialofthebottleandthecap Orthemarkthatindicatesthat	X	X	X	X	X	X
The productingredientlistforselectedorganicbase ingredients.	√	√	√	√	√	√
If fluoride is added to drinking water, the phrase fluoride added should be written on the packaging,indicatingitsfluoridecontent,mg/L.	√	-	-	-	-	-
Inthecaseoftreatedbottledwater,themethod of Sterilizationsshould bewrittenonthepackage.	√	√	√	√	X	√
Theproductiskeptinawell–ventilatedplace, Awayfromdirectsunlightandsourcesof pollution.	√	√	√	X	√	X
Environmentallyfriendlymark.	√	√	√	√	√	√

Table(3)explains themaximumallowedamount ofphysicalandessential organiccompoundsaccordingto Libyan specifications, comparing it with the label content of 6 selected random samples.

Table(3)Comparingthebasicinorganiccomponentslistedonthepackageofbottled drinking water with the Libyan specification for bottled drinking water

Parameters	LibyanSpecifications maximum allowed	A	B	C	D	E	F
TDS	500	130	130	70	130	130	115
pH	6.5 -8.5	7.5	7.5	7.5	7.5	7.2	7.5
Totalhardness	200	200	100	----	----	----	70
Bicarbonate	150	60	150	0.4	65	65	----
Sulphate	150	65	250	45	----	9.0	----
Sodium	100	14.5	45	10.2	14.5	73	10.3
Potassium	12	0.8	----	0.6	0.5	----	----

To compare the actual content of all measured parameters with the respective label content. Nonparametrical mean ± SD comparisons of locally bottled water were performed, as presented in Table 4.

Table(4)Comparison betweenLabel andRealContent inBottledLocallyLibyanWater Samples

Symbol / Parameters	A	B	C	D	E	F	Mean±SD
LabelTDS	130	150	70	130	130	115	120.83±27.27
RealTDS	80	50	40	65	55	45	55.83±14.63
LabelpH	7.5	7.5	7.5	7.5	7.2	7.5	4.950±3.83
RealpH	6.5	6.5	6.5	6.6	6.6	6.5	6.533±.05
Labeltotalhardness	200	100	----	----	----	70	61.667±80.10
Realtotalhardness	22	30	32	35	25	22	27.667±5.46
Labelbicarbonate	60	150	0.4	65	65	----	56.733±55.20
Realbicarbonate	12	15	5.5	29	48	25	22.417±15.19
Label sulphates	65	250	45	----	9.0	----	61.500±96.05
Real sulphates	17	30	32	76	48	11	35.667±23.58
Label sodium	14.5	100	10.2	14.5	73	10.3	37.083±39.26
Real sodium	55.13	62.16	41.01	36.10	22.003	18.21	39.118±17.50
Label potassium	0.8	----	0.6	0.5	----	----	.317±.36
Realpotassium	9.90	10.81	8.19	7.00	6.00	14.02	9.317±2.90

The accordingtothetestofnormalityKolmogorov-SmirnovandShapiro-Wilkthedataofthisstudy follows, missing values, and the significant difference in the results (To where To P To value To less To than To 0.05 To) To. Wilcoxon Signed Ranks Test was done, and the difference between real and label content was statistically significant (P.0.028) for the potassium and essential

(P0.345, P0.173) for total hardness and bicarbonate, respectively. (Table 5)

Table(5):MeanComparison betweenLabelandRealContentinBottledLocallyLibyan Water Samples by Wilcoxon Signed Ranks Test

Parameters	Mean±SD	95%ConfidenceInterval of the Difference		Z	Sig. * (2-tailed)
		Lower	Upper		
Label TDS–realTDS	65.000±23.66	40.166	89.834	-2.201-[b]	**.028**
Labelph–realph	1.5833±3.85	-5.6241	2.4574	-.106-[c]	.916
LabelTH–realTH	34.0000±83.45	-53.5836-	121.5836	-.943-[b]	**.345**
Labelbicarbonate– real bicarbonate	34.3167±56.03	-24.4877	93.1210	-1.363-[b]	**.173**
Labelsulfates– realsulfates	25.8333±104.19	-83.5165-	135.1832	-.314-[b]	.753
Label sodium–real sodium	2.0350±37.78	-41.6845	37.6145	-.105-[c]	.917
Label potassium–realpotassium	9.0000±3.01	-12.1644	-5.8356	-2.201-[c]	**.028**

∗Significancyp≤0.5

b.Basedonpositiveranks.
c.Basedonnegativeranks.

Table No. (6) shows the results of fluoride concentration in locally manufactured drinking water samples. The results showed that the highest concentration of fluoride was recorded for A and D samples.

Table(6)FluorideConcentrationbetween the labelandrealcontentofBottled Locally Libyan Water

Symbol / Parameters (ppm)	A	B	C	D	E	F	Mean± SD
Real fluoride concentration	0.2	0.15	0.19	0.2	0.15	0.18	**0.023±1.178**
Labelfluoride concentration	0.22	-	-	-	-	-	-

DISCUSSION:

In this study, the labels and actual contents of bottled water of 6 brands of Libyan bottled water were studied.Tothebestofourknowledge,thisisthefirststudytoinvestigatetheaccrueofthenumbers reportedonthelabeloflocalbottledwaterbycomparingitwiththelaboratoryresultsforthesame samples. The current analysis showed that the values reported on the bottle label may be accurate or overestimated, and the analyzed bottled water meets Libyan's specifications for bottled drinking water, indicating that it is, in general, safe within the established guidelines.According to the general requirements of Libyan specifications for prepackaged labeling foods, all samples of this study achieved the requirements except samples D and E,The criterion of data should be clear, irremovable, and easy to read by the consumer, was not applied as it should as shown in (table

1). All bottled water samples in this study did not record the license number and issuing authority, except for B sample where, which was registries by the ISO 22000 Professional EvaluationandCertificationBoard(PECB),andthiscertificationbody is accreditedbytheAmerican National Standards Institute (ANSI) to the ISO/IEC 17024 standard. Among the specific criteria forbottledwater, labelsspecifythetypeofbottlematerialandthecapormarkthatindicates where all samples do not have any indication. One of the essential standards in Libyan specification determines the method of sterilization of water on the label, and this is what we noticed on most of the bottled samples, except for the E sample. (6, 8). Another standard that should be mentioned on the label for the consumers is that the bottle must be kept in a well-ventilated place, away fromdirectsunlightandsourcesofpollution,whereallsamplesare recordedexceptDandF samples.Therestofthegeneralandspecificrequirementswerefullymetinallsamples,butwhat theresearchersnoticedisthattherearenopreviousstudiesontheconformityrequirements,which makes this study the first of its kind.

By comparing the number of water bottles with what was stipulated in the Libyan standard specification for bottled drinking water, No. (10) for the year 2008 AD. The presence of datarecordedonthedatacardforthepackageotherthanthedatathatmustbementionedas

stipulated in the Libyan standard specification, including chlorides, nitrates, potassium, and magnesium, in addition to not mentioning all the elements that must be recorded in the data card for the package stipulated in the Libyan Standard.The list contains the basic inorganic components of the product according to the following: ph. totaldissolvedsalts(mg/l).-sodium(mg/l).-sulfates(mg/l).-bicarbonate(mg/l).Inthedatacard for bottled drinking water of local brands, it was found that each of the two samples (A) and (B) recorded in its data label all the stipulated elements. It was also clear from the explanatory data card of the local bottled drinking water for the two samples (C) and (D) that total hardness values were not written. In contrast, sample (E) was not mentioned, and the bicarbonate and sulfates were not spun in the data card of sample (F).All samples collected from different factories did not write on their packages any statement indicating the addition of fluoride to the bottled water except for sample A. Therefore, all samples conform to the specifications, which indicates the importance of recording the concentrationonthepackageincaseofaddition.Thefluoridevaluerangedfrom 0.12to0.22 ppm. When researchers analyzed the concentration of fluoride, the results showed that all samples contain percentagesoffluoride,whichleadstothequestion of whetherthese concentrationshavebeenadded or are within the actual water content, knowing that all concentrations were within the required range.Thehighestvaluesusually occur in groundwaterandcomefromnaturalsources. (10) Generally, theaveragedailysulfate intakefromdrinkingwater,air,andfoodisabout500mg,withfood being the major source. However, drinking water may be the primary source of intake in areas high in sulfates. (11) Reasons for not setting guideline values are that there is no health concern at concentrations in drinking water, and additional precautions may impair the acceptability of drinking water. Date of assessment 2003 key references WHO (2003). (11, 12) Sulfate in drinking water is available. No data have identified the concentration of sulfates in drinking water, as drinking water can potentially adverselyaffecthumanhealth.Datafromapigletliquiddietstudyandavolunteertapwaterstudy show laxative effects at 1000-1200 mg/L concentrations but no increase in diarrhea, dehydration,orweightloss.Nohealth-basedguidelineshavebeenproposedforsulfates.However, due to the gastrointestinal effects of consuming drinking water with high sulfate levels, Libyan specifications recommend that sources of sulfate levels not above one mg/l be notified. The presence

ofsulfatesindrinkingwatercanalsocauseapronouncedtasteandcontributetocorrosioninwater distribution systems. (11-14) The researchers could not study the comparison means of all samples between the label values and real results cause some companies did not write all parameter values on their labels (missing values). In the current study, the researchers found a large discrepancy between the real valuesandthevaluesrecordedonthelabel; althoughtheyallfallwithinthepermissiblerange, this discrepancy reduces the credibility of the manufacturers. As shown in Table 5, there are significant differences(P=0.028)between the labelandrealresultsoftotaldissolvedsalts(TDS),which ranged between(70-150ppm),whiletherealresultsshowedthatthehighestvaluedidn'texceed80parts permillionwithmeancomparisonMean±SDequalto65.000±23.66.Thisiscompletelyconsistent witha studyconducted in Saudi2020, which foundthe real contentof TDS inSaudi brandsampleswas lower than the label content. Differences in the geographic regions of water origin may also explain these differences. (12, 13)

Thesedifferencesapplytoallparametersinthisstudy. A significantdiscrepancy exists betweenwhat iswrittenonthelabelandtheactualresults, asshowninTable(4). Regardingreading, thepHfor all samples was matched with mean comparison around Mean±SD equal to 1.5833±3.85 with no significant difference (P.916). Agreement physical: Physically meaningful, accurate, and labeled content; sometimes, actual content did not match quality standards. Alfaqui and Khan (2011) reported discrepancies between actual and labeled content in water samples for both Saudi and international brands. (12, 14) A previous study of bottled water samples from Ethiopia showed that some parameters, such as pH and TDS, were above reference values, while others were deficient (15). Another study also reported that 18% of water samplesfromRiyadh,SaudiArabia, exceededthereferencelimit,butthelabel values of many of the sampleswereinaccurate.Further study showedthatbottlestorageconditions can also change water composition. High temperatures can promote crystal formation and precipitation depending on the water composition. The authors suggested that the presence of Mg2+, SO42-, Na+, and K+, amongothercomponents,mightmitigatethiseffect.Storageconditionsmay explain, at least in part, the differences between actual contents and labelsfound in somestudies.(16-18)Another parameter that recorded no significant difference between the label and actual results was sodium (P.917).Althoughconcentrationsofsodiuminpotablewateraretypicallylessthan20 ppm,they can significantly exceed this in some countries, such as Libya. The maximum allowed is 100 ppm. (19) The sodium salts in air are usually low compared to those in food or water. It shouldbenotedthatsomewatersoftenerscanaddsignificantlytothesodiumcontentofdrinking water. Reason for not establishing a guideline value Not of health concern at levels found in drinking-waterAdditionalcommentsMayaffectthe acceptabilityofdrinking-waterAssessmentdate 1993PrincipalreferenceWHO(2003)Sodiumindrinking waternofirmconclusionscanbedrawn concerning the possible association between sodium in drinking water and the occurrence of hypertension. Therefore, no health-based guideline value is proposed. However, concentrations over 200 ppm may give rise to unacceptable taste. In contrast, a study conducted in Saudi Arabia showed that some water brands had the highest sodium content. (15-17) Inthisstudy,theresearchersshowthatonlysampleFexhibitedhigherlevelsofpotassiumthan proposed by the Libyan specification for bottled drinking water 14.02 ppm, with mean±SD comparison 9.0000±3.01, Z -2.201and indicated that there were significant differences between actual and label content of potassium (P 0.028).It is worth noting that sample F did not write on the label the percentage of potassium in the water, which raises controversy about the most critical health concerns related to the consumption of drinking-water treated by potassium-

basedwatertreatment(principallypotassiumchlorideforregenerationofionexchange water softeners), affecting only individuals in high-risk groups (i.e., individuals with kidney dysfunction or other diseases, such as heart disease, coronary artery disease, hypertension, diabetes, adrenal insufficiency, pre-existing hyperkalemia; people taking medications that interferewithnormalpotassium-dependentfunctionsinthebody;andolderindividualsorinfants). It is recommended that susceptible individuals seek medical advice to determine whether they shouldavoidwater consumption. In thestate, high-riskindividualshavebeenadvisedbyadietitian to avoid elevated potassium intake from water; the recommended strategy is to limit theadditionofpotassiumtowaterthatwillbeingestedortoavoidingestingsuchwater.Potassium is an essential element in humans and is seldom used, and the recommended daily requirementismore excellentthan3000ppm.Otherwise,ifthereispotassiuminthedrinkingwaterathigh levels, that could be a concern for healthy humans; overall, all drinking water samples are safe to drink, as we know that environmental change and humanactivitycanaffectthequalityandsafetyofbottledwater.Arecentstudysuggestedthatthe quality of drinking water sources has declined since 1999. Changes in the composition of water sources can pose new challenges to water treatment. These observations suggest strict bottled water management is necessary to ensure a safe water supply and avoid water containing undesirable substances or low levels of desirable compounds. (13, 12-15)

CONCLUSION

The results showed that all samples met Libyan specifications, indicating that all brands provide drinking water of high quality and fit for consumption. Moreover, the sticky contentiswithinthepermissiblevalues. Still, theactual valuesdonotcorrespondtothestickycontent except for the pH, which proves that the attached labels are not a reliable source of information about the composition and properties of bottled water. What distinguishes most of the samples is thattheyapplyexceptionalLibyanstandardsforprepackaged labeling foodsandLibyanStandard Specifications for bottled water. Given that the consumption of bottled water is increasing, the qualitycontrolofbottledwaterbecomesessential toensurethequalityofdrinkingwater.Our results are paramount to consumers, as they prove that Libyan bottledwaterissafe. Still, theirresultsmustbedocumentedandcarefullyfollowedup.Inthefuture, differencesbetweenbatchesofasinglebrandwillstillhavetobeinvestigatedtodiscoverpotential inaccuracies between batches that exceed reference values or have deviations between actual and classified content. Furthermore, careful studies of the possible adverse effects ofvariouswatercomponentsonhumanhealtharestillrequiredinclinicalresearchtoensuresafe long-term exposure.

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