Patterns of Bottled Water Consumption: a Review and Analysis

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Abstract The bottled water industry has experienced dramatic growth over the past decade. Currently, bottled water is the second most popular beverage behind soft drinks. In California, water quality standards for bottled water and tap water are comparable. Yet, the majority (70%) of Californians drink bottled water at least monthly, and one-third of Californians use bottled water as a primary source of drinking water. This study examines perceptions and knowledge of drinking water among a sub-population of Californians: undergraduate students at the University of California, Berkeley. The percentage of students that drink bottled water, knowledge of water quality, source of student's knowledge, and reasons for drinking bottled water were assessed. A self-administered survey of 300 UC Berkeley undergraduate students was employed to acquire this information. This survey concluded that most (89%) students surveyed drink bottled water at least monthly. Respondents were given knowledge scores based on six questions concerning safety, composition, and source of tap and bottled water. Advertising is the most common source of bottled and tap water knowledge. Source of knowledge is independent of both gender and major. No significant relationships were found between gender and source of knowledge or major and source of knowledge. Significant relationships were found between knowledge score and frequency of bottled water consumption and between knowledge score and source of knowledge. Students that never drink bottled water have the highest knowledge scores. Scientific literature is the least biased source of bottled and tap water knowledge. Among those surveyed, convenience is the most common reason for bottled water consumption and high price is the most common reason for non-consumption.

Introduction

Over the past twenty-five years, bottled water has climbed into a position of power in the U.S. beverage market (Gabriel 2001). Today, bottled water is a $6 billion industry nationwide (Lucas 2003). The general interest in bottled water began in the late 1970s, at a time when alcohol consumption was moderated; a fitness craze swept the country, and concerns about tap water safety developed (Hunter 2002). By the 1980s, with a vigorous promotion campaign by processors of bottled water, retail sales increased (Hunter 2002). The bottled water market grew faster than any other major beverage category, and created a multibillion-dollar industry (Hunter 2002). The majority of consumers were in California, Texas, New York, and Florida, but bottled water was consumed throughout the country (Hunter 2002). Bottled water sales have been growing at roughly 10 percent each year through the 1990s (Lucas 2003). By the late 1990s, the bottled water market was growing three times faster than soft drinks, the major beverage seller (Hunter 2002).

Americans like bottled water for what the product lacks: caffeine, calories, pollutants, and chlorine taste (Gabriel 2001). Health-conscious consumers view bottled water as a healthy alternative to diet soda (Gabriel 2001). Restaurateurs noted the rising interest in bottled water, and realized that such products could provide a growth area to make up for slackening profits from alcoholic beverages (Gabriel 2001). Bottled water boosts their dwindling bar sales and has higher profit margins than wine (Gabriel 2001). Currently, bottled water is the fastest growing segment of the beverage market (Gabriel 2001). By the end of 2003, bottled water will have moved past milk, coffee and beer to become the second most popular beverage behind soft drinks (Lucas 2003).

As consumption of bottled water increases, so does concern over whether this water is an adequate source for mass consumption. Periodic analyses of the chemical composition of bottled water have indicated that the majority of bottled water meets applicable standards (Allen 1994). However, in some samples, volatile organic compounds (VOCs) including toluene and benzene were identified (Allen 1994). This contamination, most likely introduced during processing, was attributed to inadequate process control (Allen 1994). The equipment and handling-intensive processing of bottled water provides many opportunities for the introduction of contaminants (Allen 1994). For instance, operation and maintenance of equipment (e.g., ozonators, pumps,

deionizers, bottle fillers) requires the use of lubricants and cleaning solvents which, if not adequately controlled, will contact the water product (Allen, 1994). Most bottlers use processing methods like reverse osmosis, filtration, ultraviolet light and treatment with ozone gas (Bogo 2001). Although ozone does create far fewer byproducts than chlorine, one of these byproducts is bromate, which has been shown in EPA studies to cause cancer in rats (Bogo 2001). Even though bottled water is disinfected, the microbes, nitrogen, pesticides, solvents and arsenic that have been detected throughout groundwater supplies can still be found in water bottles (Bogo 2001).

In California, water quality standards for bottled water and tap water are comparable (Allen 1994). The primary difference is that many of the organic standards for bottled water are applicable only to the source water (Allen 1994). Well water (available to 15% of Californians) being the exception, tap water is generally safe to drink (Keough 1999). Public water is tested, analyzed, and treated so that it is safe for human consumption (Keough 1999). The Centers for Disease Control & Prevention says that in most years fewer than 10,000 people report getting sick from drinking tap water in the U.S. (Sullivan 1995). Fluoride, a water additive that promotes strong teeth, is also present in tap water (Kuritzky 2000). Water systems are required to issue annual reports, called Consumer Confidence Reports (Keough 1999). In contrast, there is as yet no legislative protection for citizens to know the quality of commercial bottled water (Kuritzky 2000).

Well water, available to 15% of Californians, comes from local sources such as backyard wells or aquifers (Gaura 2003). Well water is vulnerable to contamination because it comes from underground sources. For example, 25 wells in San Martin, California contain traces of perchlorate that leached into underground aquifers from a nearby chemical flare factory (Gaura, 2003). Highly publicized accounts of contaminated well water foster suspicions over the quality of tap water (Lucas 2003). Whether these suspicions are valid depends on the consumer's source of drinking water.

The majority of Californians have access to safe surface water. Yet, 70% of Californians drink bottled water at least monthly (Lucas 2003). Over 35% of the bottled water sold in the U.S. is consumed in California and one third of Californians use such water as a primary source of drinking water (Allen 1994). Factors contributing to increased bottled water consumption may be independent of water quality data. Possible reasons for increased bottled water consumption

include one or more of the following: negative perception of tap water, superior taste, function as a status symbol, convenience, perceived health concerns, or peer pressure.

Advertising is one probable source of consumer's perceptions of bottled water. Bottled water companies sell the idea of purity, and consumers are buying it (Gabriel 2001). Images of mountains and water gushing down boulder-strewn streams label many popular brands of bottled water (Gabriel 2001). In reality, the source of water may be the suburbs, miles from any mountain stream (Gabriel 2001). One fourth to one third of bottled water classified as "purified water" originates from public water utilities (Mott et al. 1997).

Athletes and movie stars, the essence of youth, purity, and health, are also used as marketing tools (Gabriel 2001). For example, actress Lisa Kudrow provided the voice-overs for summer 2002 Aquafina advertisements, which wryly noted "Aquafina is pure nothing" (Depp 2002). Companies such as Evian market water as a status symbol (Chura 2000). Evian's assistant media director tried to reposition Evian as a fashion accessory and not just a healthy quencher (Chura 2000). Known for having the most efficient media placement in advertising, Evian targeted consumers in affluent areas of New York City such as So-Ho (Chura 2000).

In context of this social phenomenon often referred to as "the water wars," (BPI 2001) this study focuses on a sub-population of Californians: students at the University of California at Berkeley. The city of Berkeley acquires its water from the East Bay Municipal Utility District. This water system serves more than 1.3 million people in a 325-square-mile service area on the east side of the San Francisco Bay. Most of East Bay Municipal Utility District's water comes from the 577-square-mile protected watershed of the Mokelumne River, which collects Sierra Nevada snowmelt that flows into Pardee Reservoir in the Sierra foothills near the town of Valley Springs. The watershed on the west slope of the Sierra Nevada is mostly undeveloped land, little affected by human activity (EBMUD 2002).

Though the tap water in Berkeley is safe to drink, many students choose bottled water. This study determines the percentage of students that drink bottled water, knowledge of water quality, source of student's knowledge, and reasons for drinking bottled water. My hypothesis is that there is a significant relationship between gender and source of knowledge, major and source of knowledge, source of knowledge and knowledge score, knowledge score and frequency of bottled water consumption, and reasons for drinking bottled water and frequency. An

explanation for these differences is hypothesized to be anything from advertising to socioeconomic status

Methods

Samples were collected on the University of California, Berkeley campus. Located in Northern California, UC Berkeley has 21,738 undergraduate students. 10,948 of these students are male and 10,790 are female. In order to ensure a representative sample, collection sites were varied among the Northside, Sproul Plaza and Pimentel Hall locations. Collection times varied from 9am to 5pm.

The sampling instrument was a survey. Each passerby was approached and asked if he/she was a student at UC Berkeley. The same question was asked in the same way to each passerby. If the student answered yes, then he/she was asked to complete a self-administered survey.

The survey (Appendix I.) was two pages long (front and back of one sheet of paper) and asked eleven questions. Questions were designed to assess water drinking habits (question 3), knowledge of bottled and tap waters (questions 5-10), reasons for drinking or not drinking bottled water (question 4), and source of drinking water knowledge (question 11). Demographic information (gender and major) was also determined (questions 1-2).

For organizational and data management purposes, surveys were numbered and coded. Each knowledge question was assigned one point for a correct answer. Knowledge scores range from zero to six. There were a total of six "knowledge" questions that determined the knowledge score: three for bottled water knowledge and three for tap water knowledge. The first question asked about source, another asked about processing, and the third question asked about composition. Thus, the knowledge score was based on both tap and bottled water knowledge.

The statistical techniques used to analyze surveys were ANOVA, Tukey, and Chi Square tests. The effects of major and gender on source of knowledge were analyzed with a Chi Square test of significance. ANOVA was used to analyze the effect of source of knowledge on knowledge. ANOVA was used to analyze the correlation between knowledge and drinking habits. The Tukey Test was used to make pair-wise comparisons between average knowledge scores. Statistical techniques determined whether there was a significant difference in the various comparisons that were made.

Six pilot surveys were collected by November 21st, 2002. Their purpose was to improve the survey instrument, to find any of its flaws, and to see if the hypotheses are supported to any extent. After each pilot survey was conducted, feedback was requested in order to improve the sampling instrument. Since clearance had not yet been requested from the Office of Human Subjects, none of the six pilot surveys were used for analysis.

Sampling began February 10th 2003. Approximately 15 hours of work was necessary to obtain human subjects and to wait for them to complete the surveys. 325 surveys were obtained by March 26th, 2003.

Results

Most UC Berkeley students drink bottled water on a regular basis. Of those surveyed, 89% drink bottled water at least monthly, 68% drink bottled water at least weekly, 39% drink bottled water daily, and 11% never drink bottled water.

Advertising is the most common source of bottled and tap water knowledge (Figures 1 and 2)

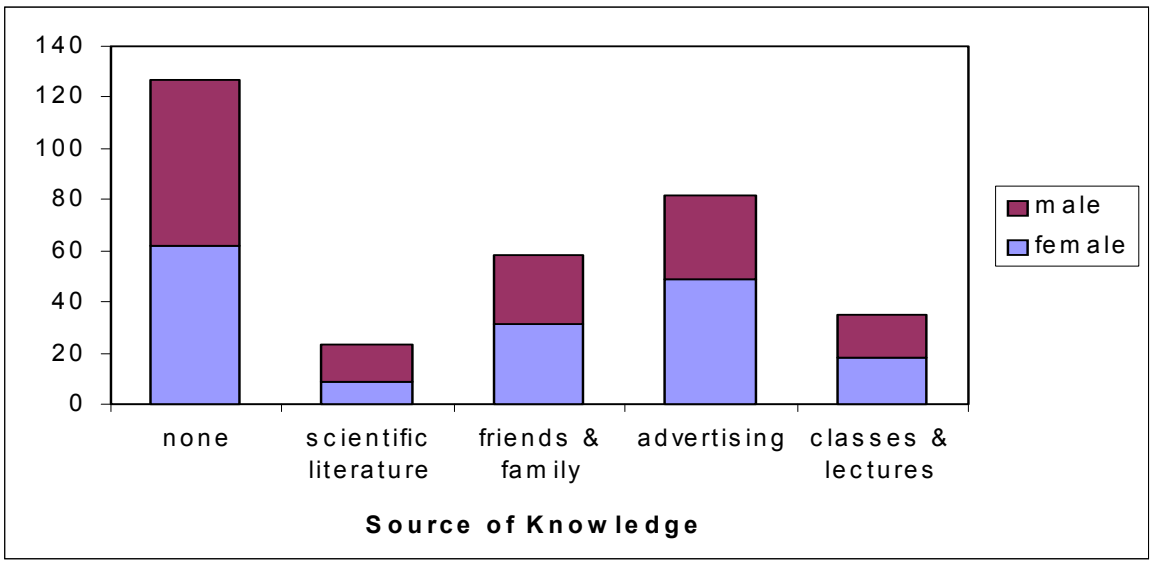

Figure 1. Source of knowledge by gender

A Pearson Chi Square test found that there was no significant difference between men and women regarding source of knowledge (X^2=4.071, df=4, p=0.3965). The Chi Square test found no significant difference between science majors and non-science majors regarding source of knowledge (X^2= 2.17, df=4, p=0.71).

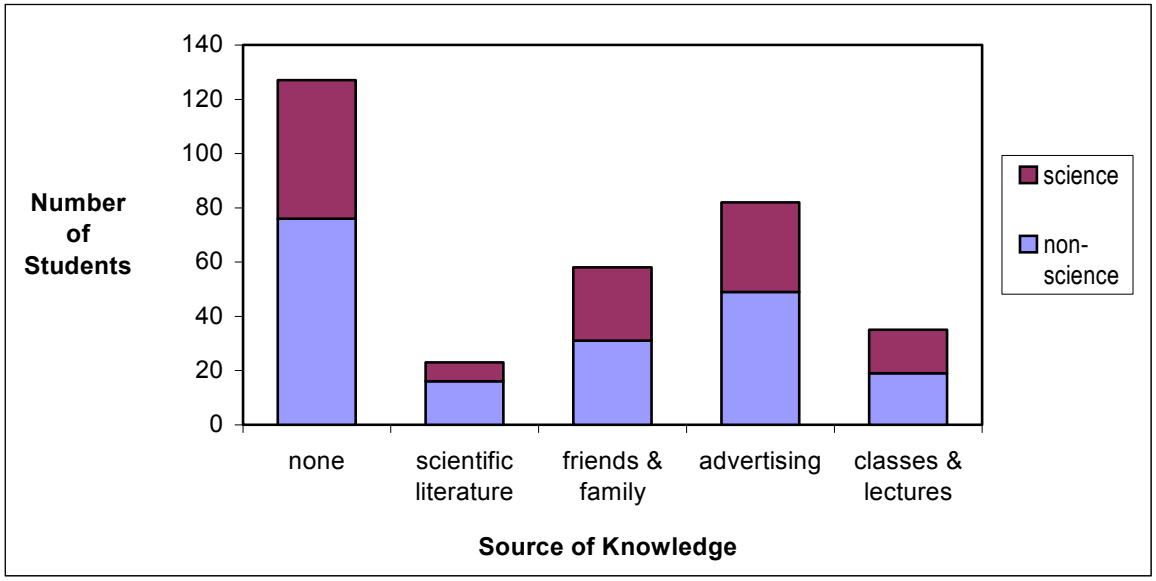

Figure 2. Source of drinking water knowledge by major

The average overall knowledge score of those surveyed was 2.77. Students that never drink bottled water had the highest average knowledge scores (Table 1).

Frequency	Pair-wise Comparison	Average Knowledge Score	N
Never	A	3.31	36
Monthly	B	2.62	68
Weekly	A	2.84	95
Daily	C	2.65	125

Table 1. Average drinking water knowledge scores by frequency of bottled water consumption

An ANOVA test determined that there is a significant difference between the average knowledge score of each frequency (N=325, df=3, F= 3.70, p=0.01). Frequency denoted by different letters in the pair-wise Tukey comparison column were significantly different at p=0.05.

Students that learn the most about bottled water from advertising have the lowest average knowledge scores (Table 2).

Source of Knowledge	Pair-wise comparison	Average Knowledge Score	N
None of the above	A	2.93	127
Scientific literature	A	3.13	23
Friends & family	A	2.69	58
Advertising	B	2.34	82
Classes & lectures	A	3.11	35

Table 2. Average drinking water knowledge scores by source of drinking water knowledge

An ANOVA test determined that there is a significant difference between the average knowledge score of each source of knowledge (N=325, df=4, F=5.17, p=0.0005). This difference is attributed to the effect of advertising on average knowledge score. Frequency determined by different letters in the pair-wise Tukey comparisons column were significantly different at p=0.05.

The most common reason for drinking bottled water is convenience. Of students that drink water on a daily basis, their reasons are convenience (60%) safety concerns (12%) health improvement (14%) and superior taste (14%).

The most common reason for not drinking bottled water is its high price. Of students that do not drink bottled water, their reasons are high price (61%) inconvenience (22%) and no concerns about the safety of drinking water (14%).

Discussion

Most (89%) of UC Berkeley students surveyed drink bottled water on a regular basis (at least monthly). Source of knowledge does not depend on gender or major. There are no significant differences between men and women or science and non-science majors regarding where they obtain water quality knowledge. Advertising is the most common source of water quality knowledge for men and women, science and non-science majors. Advertising is the only source of knowledge that is significantly different from other sources of knowledge.

The students that have the most knowledge about bottled and tap water are those that never drink bottled water and those that learn about drinking water from scientific literature. There are significant differences in water quality knowledge among the different frequencies of bottled water consumption. Since the average knowledge score is highest for students that do not drink bottled water, it may seem that lack of knowledge causes one to drink bottled water. However,

students that drink bottled water cited convenience as the most common reason for their consumption. Thus, knowledge is less of a factor in bottled water usage. Knowledge is more of a factor in the decision to not use bottled water.

Where students learn about bottled water affects knowledge. There are significant differences in water quality knowledge among the different sources of water quality knowledge. Previous studies (Gabriel, 2001) have exposed the fact that advertising images aren't required to reflect reality. Consequently, pictures of waterfalls may be used to sell municipal tap water. Since the average knowledge score for bottled water drinkers is low (less than 50% of questions answered correctly), this supports my hypothesis that advertising is a poor source of water quality knowledge. Since the average knowledge score for students that learn from scientific literature is highest, this may indicate that scientific literature is the least biased source of water quality knowledge.

The dramatic increase in bottled water consumption over the past five years may be attributed to convenience and to advertising. While some brands of bottled water promote images of youth, health, and purity, (Gabriel, 2001) others sell bottled water as a status symbol or fashion accessory (Chura, 2000). Though these images affect student's perceptions of bottled water, my study shows that students follow through with purchasing bottled water because of convenience.

Most students surveyed cited convenience as their main reason for buying bottled water. Those that do not drink bottled water make this choice based on its high price. If bottled water companies are interested enticing more consumers to buy bottled water, they should decrease its price. Most importantly, the low knowledge scores of bottled water drinkers indicate that bottled water companies should be held to higher advertising standards.

Acknowledgements

I would like to thank Devon Alcosser, Elizabeth Maier, and Leah Jin for collecting surveys with me. I also thank Manish Desai, Matt Orr, and John Latto for helping with the entire thesis process.

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Appendix A. DRINKING WATER SURVEY

Please answer the following questions to the best of your knowledge.

1) Circle one: Male Female 2) Declared/Intended Major: _____

3) How often do you drink bottled water (check ONE):

___ every day
___ at least once a week
___ at least once a month
___ never

4a) If you drink bottled water, what is your #1 reason for buying it? (check ONE):

___ superior taste
___ health improvement
___ safety concerns
___ convenience

4b) If you don't drink bottled water, what is your #1 reason for not buying it? (check ONE):

___ high price
___ inconvenience
___ no safety concerns

5) Where do Dasani and Aquafina bottled waters come from? (check ONE):

___ underground wells
___ municipal tap water
___ mountain springs
___ geysers

6) Which is the safest bottled water (check ONE):

___ spring water
___ purified water
___ artesian well water
___ natural mineral water

7) Where Berkeley's tap water come from (check ONE):

___ underground wells
___ protected watershed/reservoir
___ mountain springs
___ geysers

8) Of the two main types of tap water, surface and well, which is safer (check ONE):

___ surface water
___ well water
___ they're equally safe
___ don't know

9) What is true about ozone gas and chlorine when they are used to disinfect water (check ONE):

___ chlorine can produce harmful byproducts; ozone gas cannot.
___ ozone gas can produce harmful byproducts; chlorine cannot.
___ both ozone gas and chlorine can produce harmful byproducts.
___ neither ozone gas nor chlorine produce harmful byproducts.

10) Arsenic, microbes, and pesticides have been found in (check ONE):

___ bottled water
___ tap water
___ both bottled water and tap water
___ neither bottled water nor tap water

11) Where do you learn the most about drinking water (check ONE):

___ classes/lectures
___ advertising (TV, magazines)
___ friends/family
___ scientific literature
___ none of the above