CHAPTER II

REVIEW OF LITERATURE

INTRODUCTION

Review of literature gives an understanding of the previous studies that has been already done on the awareness and attitudes about packaged drinking water. The main aim of review of literature is to know what has already been done about the packaged drinking water field and how all drinking water studies relate to earlier researches. This overview of the findings of previous packaged drinking water studies helps us to identify general patterns of the findings and the conclusions that have been made. It provides an insight into how the study of consumer’s attitudes towards packaged drinking water and their awareness of its impact on their health in the southern districts of Tamilnadu is similar to or different from previous studies at national and international levels. This review of literature suggests that majority of consumers do not understand the crucial role of packaged drinking water regulations in healthy living.

Gabriel (2001) in his study has revealed that over the past 25 years bottled mineral water has climbed into a position of power in the world market. By the late 1990s, the bottled mineral water market was growing three times faster than soft drinks as the major beverage selling substance. He also reported that the world market of bottled mineral water has grown quickly and is considered as a global billion dollar business. The bottled water consumption has been steadily growing up over the last three decades at the global level and it is one of the fastest growing and the most dynamic sector in the food and beverage industry.¹
Shrivastava Brajesh.K and Alam Massod (2007) stated that the total production and cumulative water consumption of various treatment units used in water treatment at Rail Neer Plant, Nangloi, Delhi meet the Bureau of Indian Standards specifications for packaged drinking water” (IS : 14543 : 2004) and various amendments incorporated till Feb, 2006. The treatment system comprises chlorination, activated carbon filtration, pesticide removing system, softner, ultrafiltration, reverse osmosis, marble chip filtration unit, micron filtration, UV disinfection and ozonation.²

Bhushan’s article reports that “the per capita bottled water consumption in India is still of unit less than five litre a year as compared to the global consumption of 24 litre. However, the total annual bottled water consumption has risen rapidly in recent times, it has tripled in 1999 and 2004 from about 1.5 billion litres to five billion litres. These are boom times for the Indian bottled industry more so because the economics is sound and the Indian government hardly cares as to what happens to the nation’s fastest growing industrial sectors.³

Jeya (2007) in her dissertation concludes that water is a main part of human beings’ daily life. The consumers have their choices towards the mineral water. Brand names of the mineral water play an important role in designing the attitude of the consumers. Different attributes of the mineral water influence the purchase decision of consumers. Buyer behaviour is the psychological, social and physical behaviour of potential consumers as they are able to evaluate, purchase, consume and tell other people about the products and services. It is the act of considering different facts of benefits expected from the product before affecting the purchase of the product”.⁴
Nithiyanandan (2000) in his project entitled “Market status of mineral water industry with special reference to TEAM” reveals that consumption patterns are changing in packaged mineral water industry. Mineral water is now served on trains and aeroplanes. Besides the standard one litre bottle which is still the largest seller, a variety of pack size have been introduced. Mineral water is now available in 200 ml pouch, 500 ml bottle, 1 ltr. and 2 ltr. bottle, 5 ltr. jar and 20 ltr. can. Trains involved in travel for two days and more require about 50,000 litres of mineral water for a journey. In the modern day living, stressful working conditions and demanding life styles make the body lose its electrolytic balance. With companies positioning mineral water as ramification of health, it has made the market potential limitless”.

Sasirega Ramani and Sudharsava Reddy (1999) in their work, 37.14% of the respondents were using packaged drinking water for health purposes. Of these, 16.43% of the respondents were using packaged drinking water as it is hygienic, 6.43% of the respondents were using packaged drinking water as it is easy to use, 2.29% of the respondents use it for ‘need not carry water’, 4.29% of 6.43% of the respondents were using it as it avoids wastage of water, 20.71% were using it due to employees’ demand, 5.71% were using it due to the presence of salt in the water. On the whole, majority of the respondents were using packaged drinking water for health reasons.

Sivaji Ganesan (2007) in his research study concludes that since packaged drinking water has tremendous impact on human health, both the manufacturers and consumers must be diligent. The present day consumer market is flooded with a number of packaged drinking water brands. But the average consumer of packaged drinking water always tends to give more importance to quality and taste which is followed by
competitive price, so manufacturer should focus on producing packaged drinking water with good quality and supply it at reasonable prices. A retailer with an in-depth knowledge of the consumers’ preference and behaviour pattern will be able to cater to them and will emerge triumphant in the present day cut throat competitive market”.  

Samek (2004) in his study explained that part of the growth of mineral water sector can be attributed to perceptions created by bottling companies through advertisements promoting their water as “pristine” and “fresh” emerging from glaciers and mountains. This significant shift in consumer preferences has environmental implications since a portion of the current pressures on freshwater sources could be driven by the needs of bottling companies and could cause irreversible damage. Florida presents an interesting case study in terms of freshwater resources and bottled water. It has the highest number of first magnitude springs in the world and has a significantly low number of problems with the safety of tap water. For this reason, Floridas water resources are thus a major target of bottling companies.  

Miller (2006) analysed that the U.S. consumers are opting to pay much higher prices for water that comes in a bottle despite access to reasonably priced domestic water. Although U.S. public water systems are arguably the safest in the world, bottled water has become so popular that grocery stores can now sell in-house brands for a smaller cost than premium name brands of bottled water with guaranteed profits because they are undoubtedly just using regular tap water.  

Maier et al., (2006) suggest that taste could also be a primary reason why consumers turn to bottled water, which is interesting considering a filter would solve the issue of taste for a fraction of the cost. There is also the possibility that most perceptions
about bottled water are incorrect, and one of the goals of their study was to find out to what extent this is true.\textsuperscript{10}

Natural Resources Defense Council (NRDC, 1999) reported that most consumers widely believe that bottled water is better for them due to added health benefits, even as this is not the case. Bottled water is also perceived to be safer than most tap water, when in fact nearly all U.S. residents have access to safe and reliable drinking water.\textsuperscript{11}

AWWA (2001) a survey conducted by the American Water Works Association revealed that 35\% of people drink bottled water because they were concerned about tap water safety, 35\% drank it as a substitute for other beverages and 12\% chose to drink it for both of those reasons. 18\% drank it because of taste, convenience, or other reasons.\textsuperscript{12}

Beverfood (2008) in his study revealed that consumption of bottled mineral water is increasing significantly worldwide, becoming an important factor both in economic and health issues. This is particularly true for Italy, since the country has the largest producers (over 12 billion L/year) and consumers (200 L/per capita/year) of bottled water in the world.\textsuperscript{13}

Frost and Sullivan (2007) in their study concluded that bottled mineral water consumption in the world is increasing by an average 7\% each year, inspite of the fact that bottled mineral water has a higher price. The convenience of bottled water that can be easily purchased at retail outlets and is easy to use is the major factor leading many people to purchase bottled mineral water. These factors have led to the increasing global production of bottled water, from estimated 142 billion liters in 2002 to over 173 billion liters in 2006. Danone, Nestle, Coca-Cola and PepsiCo are the world's top four bottled mineral water companies. Although Coca-Cola and PepsiCo are known as the big
carbonated soft drinks manufacturers, they have also noted the potential in the bottled mineral water market and have been developing their brands and capabilities in this market. Although major consumers of bottled water are in Europe and North America, the most promising markets are in Asia and Pacific with an annual growth rate of 15%.  

Latinopolous et al., (1997) observed that a serious health effect that may be caused by groundwater contamination is the reason for the increasing of public concern about the quality of groundwater resource in recent years. At present, the public is getting more concerned about their health whereby they are more interested to know about the water they consume.  

Guler (2007) in his study stated that fresh water is insufficient, and resources are unevenly distributed throughout the world, with much of the water located far from human population. In his study he also revealed that in countries with scarce water resources, consumption of bottled mineral water is a growing practice. Growing population and the population shift from rural to urban areas have increased the consumption of bottled water worldwide.  

Saad et al., (1998), in their study stated that nowadays many people living in urban areas are increasingly consuming bottled mineral water because it is seldom associated with naturalness, objection to unpleasant tastes and odors from municipal water supplies and because bottled mineral water is often regarded as safe as and healthier than tap water. Furthermore, the efficient marketing and advertising strategies followed by the bottled water producers enhanced this consumption. An evidence is the fact that especially consumers who live in developed countries buy bottled water as a
healthy alternative to other beverages, to improve their diet and health. Bottled water is called the packaged water that is commercially available for human consumption.\textsuperscript{17}

Rusconi et al., (2004) in their study stated that bottled mineral waters have always been regarded as voluptuary good, something between a soft drink and a dietary or medical aid with a limited importance in human diet. They also claim that the increasing use of bottled mineral water makes it obvious to consider it an important element of the human diet, with special regard to children in lactation age.\textsuperscript{18}

Misund et al., (1999) revealed that bottled mineral water can be defined as water that is intended for human consumption and is sealed in bottles or other containers with no added ingredients except that it may contain safe and suitable anti-microbiological agents. In their study they also indicated that most bottled mineral waters are groundwater, bottled with or without some treatment process such as filtration and sterilization.\textsuperscript{19}

Rusconi et al., (2004) in their study analysed that in the last years, anyway, the consumption of bottled mineral water has widely increased in all western countries. For example, in the period 1990 until 2000, mineral water consumption rose 50\% in Germany and 130\% in the USA. Italy is the main mineral water producer in the world: 9,500 million liters have been bottled in 2000, 700 million of which have been exported. Between 1995 and 2000, the national production rose by 55\% and export by 120\%. Italy is also the main consumer of bottled mineral water. The national market absorbs more than 90\% of the whole production.\textsuperscript{20}

Khan and Chohan (2009) also have postulated that according to the latest statistical report, the global consumption of bottled water reached 162 billion liters in
2005, an increase by 52% from the 107 billion liters consumed 5 years earlier. This increase was quite stable with reference to population growth. However, the large consumption of bottled drinking water per person was mainly due to low level of fluoride concentration and apprehension and about the contaminants of communal drinking water, fewer impurities, better taste, and possibly, conferring higher social status.\(^{21}\)

King (2008) in his study stated that the consumption of bottled mineral water is significantly increasing worldwide and has become an important factor both for economic and health issues. In several countries, the production of bottled mineral water has recently increased (e.g., Poland, Hungary, Greece) (UNESDA).\(^{22}\)

Back et al., (1995) and Albu et al., (1997) in their study stated that the consumption of bottled water in the West is connected with old traditions of healthy mineral springs, a custom that is rooted in the distant past. In their study they also stated that nowadays, the consumption of bottled water in developed countries is more and more connected with public dissatisfaction with public water supplies and greater environmental concerns. If, in the past, drinking water from the bottle was mainly for therapeutic purposes, today it is a many-faceted sociological phenomena connected with various urban cultural strategies.\(^{23}\)

Codex Alimentarius Commission, (2001) reported that bottled i.e. “packaged” water is considered drinking water under some regulatory schemes and as a food in others. Some authorities distinguish natural mineral water from other bottled waters. WHO Guidelines for Drinking Water Quality are referred to directly in international norms and are considered applicable to bottled waters.\(^{24}\)
Leslie (2000) says that the 2001 census reported that 68.2% of households in India have access to safe drinking water. According to latest estimates, 94% of the rural population and 91% of the people living in urban areas have access to safe drinking water. While accessing drinking water continues to be a problem, assuming that it is safe is challenging by itself. It has been estimated that globally 1.20 billion people become sick annually due to poor quality of drinking water. Further, according to WHO, 80% of diseases of human beings are caused through medium of water and 1800 million man working days are lost in India due to such water borne diseases (Rural Drinking Water, 2000).25

Kiran Gadre (2004) asserts that natural water is contaminated by a wide variety of pollutants and has to be purified to make it safe for drinking. Polluted drinking water is the cause of several diseases. Increased awareness about the quality of drinking water has created a growing market for safe drinking water packed in bottles or containers. Standards have been formulated in every country to ensure the quality of packaged drinking water. Choice of the process of manufacturing packaged drinking water depends on the contents of raw water and several techno-commercial factors.26

Dinesh Chand (2006) in his article says that “Better rainwater management can help in reducing the impact of drought in semi-arid regions. Relatively cheap and simple water conservation devices such as spray taps and simple rainwater butts can offer short payback periods and should be considered before high-tech rainwater, harvesting or recycling of grey water. Although, rainwater harvesting techniques appear to be simple but the full benefit could only be gained by adopting a scientific approach
implementation together with community awareness, their involvement and legislative measures for protection of ground water from over exploitation.27

Harendar Raj Gautham et al., (2006), in their research study observe that, “According to an estimate of the Central Ground Water Board, if we continue to exploit our ground water indiscriminately, then in the next 20 years, 15 states of the country may face shortage of underground water. The ground water boom is turning to bust. Problem is severe and keeping in view the fact that agriculture is the backbone of our economy. The central government has accelerated continuous higher budgetary support in recent years to rainwater harvesting and watershed schemes to recharge our underground water sources. Excess digging of wells should be avoided or restricted. Permission for digging of wells should be linked with construction of water harvesting structures. In urban areas, harvesting of rainwater should be made mandatory so that the water stored could be used for other than drinking purposes. We have to keep in mind that we cannot make more rains, so we have to manage water better”.28

Batt et al., (2006) in their study concluded that drinking water wells are often located in the vicinity of streams because streams often overlie permeable sediments and the water table is near the surface in valleys so that pumping costs are low. The lowering of the water table by pumping wells can reverse the natural flow from the groundwater to the stream, inducing infiltration of surface water to groundwater and subsequently to drinking water wells. Unfortunately, surface water bodies are particularly vulnerable to contamination from industrial and municipal wastewater, leaching or runoff of agrochemicals and dissolution of airborne pollutants.29
Rodwan (2009) in his study stated that the bottled water market has been growing since the middle of the 1970s, and this has especially been the case in the last ten years.\footnote{30}

Hemphill (2008) pointed out that the bottled water companies have recently set unprecedented records in sales, surpassing all other types of non-alcoholic beverages to become the second largest beverage market next to soda.\footnote{31}

Miller (2006) finds bottled water to be an adequate choice in geographic regions which lack access to safe drinking water but not as a substitute in the U.S. His opinions are supported by the United Nations Food and Agriculture Organization and the World Wildlife Foundation.\footnote{32}

Malaysia's Food Regulation (1985) reported that the popularity of bottled mineral water with consumers has increased due to the increasing contamination of water resources. Natural mineral water is water that clearly comes from underground sources. It is distinguished from ordinary drinking water because it is characterized by its content of certain mineral salts and their relative proportion and the presence of trace elements of other constituents. Besides that, natural mineral water is also defined as groundwater that obtained directly for human consumption from drilled or natural sources from underground water.\footnote{33}

Nickson et al., (1998) in their study denoted that the most severe contamination of groundwater was recently discovered, where millions of people are at risk and consumption of the heavy metals contaminated water has caused widespread death and disease. In their study they also stated that heavy metals are critical in this regard because of their easy uptake into the food chain and because of bioaccumulation processes.\footnote{34}
Department of Environment (2005) reported that the overall trend points to a slow but steady worsening of the water quality of rivers around the country. Among the river systems as a whole, with or without confining reservoirs, 97% are estimated to contribute to the raw water supply source. In their study they stated that the increasing population growth, coupled with rapid agricultural and industrial development, the availability of small numbers of water resources to meet increasing water demand is fast becoming a pressing issue. Due to lack of access to clean water resources, consumption of bottled mineral water has increased.35

Wilson et al., (1983) stated that groundwater comprises water obtained from springs or from wells and boreholes that used to catch water from the aquifers by means of pumps. Deep wells or boreholes provide usually water of excellent bacteriological quality. Groundwater is therefore often used without any treatment, except with physicochemical ones to reduce hardness or eliminate flavors and odors.36

Leeuwen (2000) reported that there are many sources of contamination of drinking water. Widely they can be categorized into two categories that are contaminants inside the ground and surface water. The sources for drinking water production and contaminants are several involved during the treatment and distribution of drinking water. Contaminants in ground and surface water will range from natural substances such as leaching from soil, run-off from agricultural activities, controlled discharge from sewage treatment works and industrial plants, and uncontrolled discharges or leakages from landfill sites and from chemical accidents or disasters. Contaminants that occurred naturally are predominantly formed by inorganic compounds such as arsenic and manganese, which are derived from natural mineral formations. Organic compounds,
pesticides, disinfectants and disinfectant by products are usually introduced by anthropogenic activity.\textsuperscript{37}

Natale et al., (2008) in their study stated that the presence of toxic pollutants in groundwater has to be avoided in order to preserve the environmental quality because it can bring about significant changes in the properties of water resources.\textsuperscript{38}

Botezatu et al., (2005) in their study analysed that mineral water run across highly mineralised rocks. The geological sources of natural mineral water are known as aquifers, which can be from different types, and they differ greatly in terms of their depth, horizontal extent, composition, and permeability. Water filtering underground flows slowly through deep permeable rocks and sediments and diffuses into the empty interstitial space of the rocks. Water picks up minerals and other elements depending on the chemical make-up of the strata while passing through the underground strata. This is why they have higher concentrations of minerals and trace minerals than other kinds of water.\textsuperscript{39}

Misund et al., (1999) in their study analysed that natural mineral water is characterized by its mineral content, trace elements or other constituents and, where appropriate, by certain effects and also by being in its original state, both conditions having been preserved intact because of the underground origin of the water which has been protected from all risk of pollution. The composition, temperature and other essential characteristics of natural mineral water would remain stable at source within the limits of natural fluctuation. In particular, they would not be affected by possible variations in the rate of flow. Mineral waters may be gaseous or non-gaseous.
Disinfections are not allowed in terms of treatment. The only treatment authorized is filtration or decanting and the addition or removal of carbon dioxide.\textsuperscript{40}

Cemek et al., (2007) in their study pointed out that water quality can have a major impact on both individuals and communities health. Water may contain substances, whether natural or through human activity, that can affect the quality and existence of life. It is important to recognize between pure water and safe water. Pure water can be defined as water that is free from all unrelated substances, whether it can be harmless to health or not and is impossible to produce. On the other hand, safe water is water that is not likely to cause undesirable or adverse effects, although it may contain certain pollutants. It should be clearly distinguished that drinking water should be clean and safe, and that minute quantities of contaminants present in water should meet the drinking water guideline set by the World Health Organization to protect people's health.\textsuperscript{41}

Orzturk and Yilmaz (2000) in their study concluded that there is an increasing concern worldwide about the quality of drinking water. They also revealed that the levels of some water quality constituents in drinking waters are in violation of action levels for various parameters, especially some toxic trace metals. They also suggested that the increasing exploitation of mineral waters, not only for drinking waters but for medical purpose also requires a complete evaluation of all the important sources and not only the main constituents but also trace components should be determined. Hudnik also states that the occurrence of many heavy metals can be low in mineral waters.\textsuperscript{42}

Soupioni et al., (2006) in their study pointed out that our bodies required minerals which are chemical elements for numerous biological and physiological processes that are needed for the maintenance of health. They are classified into two categories. Those
that is required in our diet in amounts greater than 50 mg per day, called minerals, and those that are required in amounts less than 50 mg per day, which are called trace elements. Recent epidemiological studies have indicated a strong association between the occurrence of several diseases in humans and the presence of trace elements considered to be toxic such as As, Cd and Pb and as well as excessive or deficient levels of essential micronutrients such as Co and Zn, despite the fact that trace elements constitute only a small fraction of the total uptake of food.\textsuperscript{43}

Baba et al.,\textsuperscript{(2008)} observed that trace elements are present in living organisms at very low levels but some of them are important in many different biochemical reactions that occur in the human body. They also reported that in recent decades the flow from the hydrosphere to man for several heavy metals such as As, Pb and Hg has increased abundantly due to seasonal inputs caused by using pesticides, or due to natural release from the soil into groundwater.\textsuperscript{44}

Hsu\textsuperscript{(2005)} in his study reported that heavy metals can be related to many anthropogenic sources and their compounds are extremely toxic and are among the most dangerous inorganic water pollutants. Many heavy metals accumulate in the aquatic food web reaching human beings through the food chain, and causing several diseases. The presence of heavy metals in groundwater is due to water exchange with contaminated rivers and lakes or to leaching from contaminated soils by rainfall infiltration. Hence, it is a major challenge for environmental engineering to remove the heavy metals from groundwater.\textsuperscript{45}

Karamanis et al.,\textsuperscript{(2007)} in their study stated that ions such as sodium, potassium, magnesium and calcium are essential to sustain life. Additional metals such as
manganese, iron, cobalt, copper, zinc, chromium, vanadium, selenium and molybdenum are also essential for optimal growth, development and reproduction. These metals function mostly as catalysts for enzymatic activity in human bodies but become toxic, when their concentration becomes excessive. In addition to the metals essential for human metabolism, water may also contain toxic metals like mercury, lead, cadmium, silver, aluminum, arsenic and barium. Epidemiological studies in recent years have indicated a strong association between the occurrence of several diseases in humans, particularly cardiovascular diseases, kidney-related disorders, neurocognitive effects and various forms of cancer and the presence of toxic trace metals.  

Baba et al., (2008) reported that up to now, there has been much debate about the health giving effects of mineral water. Apart from the obvious function of providing liquid to the body, there are no scientific studies that actually show a significant beneficial effect of mineral water on the health. While mineral water clearly contains minerals that are, in principle, beneficial for the body, the ability of the body to absorb them from mineral water is not exactly proven. But since natural water is free of any calories, sugar or artificial ingredients, it is certainly better than a sweetened, flavored soft drink. There are usually no adverse effects from drinking mineral water and so we may drink it just for its fresh taste.  

Petraccia et al., (2006) in their study analysed that labels on bottled mineral waters are regulated by legislative norms. Labels contain two kinds of information that are information about the producer and the production which is brand name, production lot, bottling date, bar code, the words about the natural environment, nominal content, authorization, purchase proof and consumer service toll-free number. The label or the
bottle must also show a regular hexagon or a circle with an abbreviation indicating the material of the container. The second kind of information guides the consumers in the choice of the water which best meets their requirements. The label also reports some basic rules for a correct storage of bottled mineral water that is to be kept in a cool, dry, clean and odourless place, away from light and heat sources. After the opening, the bottle must be closed carefully, in order to maintain the original characteristics.48

Misund et al., (1999) reported that the regulation of contents of bottled mineral water is not stringent and the concentration printed on the labels may not be accurate. One study in Pakistan showed that about 52% of bottled water was not suitable for drinking. A study (Johnson and DeBiase, 2003) was conducted in European countries to compare the actual level of different elements to the concentration mentioned at the bottle.49

Jeenaa et al., (2006) in their study pointed out that the introduction of packaged water for human consumption at recent times is a boon to mankind and more convenience is realised. Whenever someone purchases packaged water, he thinks that the quality is assured and it is safe water. The use of bottled water may have begun as a fad but this industry has evolved into one of the fastest growing industries in India. Increased public awareness about waterborne disease outbreaks and lack of safe drinking water supply during travel have also resulted in an increased demand for bottled drinking water. In India, a large population of road and rail commuters depend on bottled mineral water for their drinking water needs during travel.50

LeChevallier et al., (1980) in their study analysed the heterotrophic plate counts (HPC), expressed as colony-forming units (CFU), became one of the standard techniques
for microbial water quality testing. Health significance and occurrence of injured bacteria in drinking water as well as potentially pathogenic features of heterotrophic plate count bacteria from treated and untreated drinking water have been reported.\(^{51}\)

An anonymous (1980) revealed that in certain parts of the world, disinfection or sterilization of commercially available mineral waters is not permitted. Therefore, they generally have high heterotrophic plate counts (HPC) a few days after bottling that should result only from an increase of bacteria present in the source water.\(^{52}\)

Murali and Ramesh (2007) in their article disclose that from being confined to the uppermost echelons of society, packaged water has now become a common place commodity and almost a dire necessity in metros. The industry’s phenomenal growth in the recent years can be attributed to the rising incidence of water-borne diseases, improper municipal supplies, and the evolved health consciousness of people as well as globalization which has brought in tremendous tourist inflow. Now since the industry has matured, only big companies with branded products are in the fray to capture the large market share. Though the industries’ growth rate is 40-50\% a year, India is still much behind the countries such as Indonesia, Malaysia and Singapore, where the industry is already worth Rs. 15,000 to 20,000 crores, though, these countries have much smaller populations but similar climatic conditions.\(^{53}\)

Leivadara et al., (2008) in their study revealed that bottled water’s wide acceptability is related to the convenience and taste it provides along with the belief that it is purer than tap water, making it a healthy alternative to other beverages.\(^{54}\)

WHO, (2003b) reported that packaged waters with very low mineral content, such as distilled or demineralized waters, are also consumed. Rainwater, which is similarly
low in minerals, is consumed by some populations without apparent adverse health effects. There is insufficient scientific information on the benefits or hazards of regularly consuming these types of bottled waters.\textsuperscript{55}

Freuze et al., (2006) observed that trihalomethanes are generated during the process of chlorination of tap water. Leaching of chemicals from packaging materials and possible intentional or accidental contaminations can contribute VOCs to contamination of waters. Pathogenic organisms are usually removed from processed drinking waters by chlorination to adequately safeguard public health.\textsuperscript{56}

Rosenberg (2003) in his study concluded that most bottled waters are taken from springs or ground waters. Natural mineral waters are not sterile environments, but complex ecosystems with a high phenotypic and genetic diversity of autochthonous bacteria.\textsuperscript{57}

Kosek et al., (2003) in their study analysed the contaminated drinking water, along with inadequate supply of water for personal hygiene and poor sanitation and concluded that it is the main contributor for an estimated 4 billion cases of diarrhoea each year causing 2.2 million deaths, mostly among children under the age of five in developing countries.\textsuperscript{58}

WHO (2004) reported that 1.1 billion people lack access to improved water supplies; many more are forced to rely on supplies that are microbiologically unsafe. While universal access to safe, piped-in water is an important long-term goal, this is likely to be elusive for many years to come due to the costs of building and maintaining such systems. Improving the microbiological quality of drinking water, particularly at the
household level, is effective in preventing diarrhoea in settings where it is endemic (Clasen et al., 2006).

Afzal (2006) in his study stated that contaminants can be differentiated as inorganic or organic chemicals, radionuclides, and microorganisms. They may occur naturally or enter the watershed from farming or industrial discharges. Examples of inorganic contaminants are lead, nitrates, and arsenic. Organic chemicals contain carbon and access the watershed from agricultural and industrial run off. Volatile organic chemicals are persistent in the environment and have been associated with cancer and neurological and reproductive health effects. Examples include gasoline and degreasing and dry cleaning solvents. There are over 30 standards for synthetic organic chemicals, many of which are pesticides.

Ekmekcioglu (2000) conducted a detailed study on the mineral water. Mineral water may represent a good source of nutrition which is necessary for the needs of human body.

Baba et al., (2008) in their study stated that human beings required minerals for nutrition, growth, sustaining body functions and well being. They also reported that these minerals have various effects on the human's health.

Albu et al., (1997) in their study reveal that natural mineral waters have long been used for medical purposes. The term natural mineral water is defined so as it originates in an underground water table or deposit; it differs from treated water in its original purity that is bacteriologically healthy and its content of minerals, trace minerals and other constituents must remain constant. Only natural mineral water has the characteristics that can benefit human health.
Petraccia et al., (2006), in their study indicated that the mineral waters are of underground origin, protected from contamination, and microbiologically wholesome. They present a peculiar and constant chemical composition, and have favorable effects on health. To ensure it is safe, they must be bottled at source and checked containers. Mineral water does not simply mean containing minerals. In fact waters that run underground and are enriched with minerals by contact with rocks cannot be considered mineral waters if they do not possess therapeutic properties.64

Petraccia et al., (2006) in their study suggested that natural mineral waters can be classified into potable waters, dietetic waters, and healing waters. Bottled dietetic waters showed that it can be used to restore salts and hydrate through experimental evidence and are useful in low sodium diets and provide the right calcium intake in particular conditions. Healing waters possess pharmacological and clinical properties related to prevention and treatment of specific pathologies. They are used in thermal establishments, under medical control, for drinking, irrigations, inhalations, and baths. The main classification parameters for mineral waters are rate of flow, temperature, freezing point, dry residues at 180oC, predominant ion composition, and predominant biological activity.65

Petraccia et al., (2006) reported that 9% of the waters on the market are waters with a very low mineral content. These waters have a diuretic effect and are used in treating urinary stones; they facilitate uric acid clearance. They are suitable for powdered milk dilution since they do not modify its formulation and also is useful in hypertension for their low sodium content. 65% of mineral waters on the market are waters with a low mineral content. They have diuretic effects, and are strongly used in urinary stones and
gout because facilitate uric acid and ureic nitrogen clearance. 20% of the mineral waters on the market are waters with a medium mineral content. They are similar to low-mineral waters in the action, but their diuretic effect is inversely proportional to the amount of dry residues. 6% of the mineral waters on the market are waters rich in mineral salts and are defined as medicinal waters.\textsuperscript{66}

Cemek et al., (2007) in their study stated that a reliable supply of clean drinking water is extremely important to protect the health of individuals and communities. Both the quantity and the quality of supply are important. Since diseases are more easily transferred directly from person to person via contaminated food or water an adequate quantity of water is of primary importance in public health. A number of serious diseases can be spread via contaminated drinking water. Although water is important for living, poor water quality due to sewage and industrial and agricultural effluents can mean increased exposure to carcinogenic compounds, insecticides such as DDT, and heavy metals. There has been an increasing demand for natural mineral waters due to human health benefits caused the increasing contamination of tap waters and this has led to more and more consumption of mineral waters recently. Heavy metal levels in the natural waters are important indicators of water quality. The increasing concentration level of heavy metal becomes an important problem for public health. Thus, widespread and frequent monitoring surveys must be carried out.\textsuperscript{67}

WHO (1998) reported that there are elements that are essential for growth and may have beneficial uses but even though these some of these trace elements are essential to human, but essential as well as non-essential elements if raise to a higher level or status can cause morphological abnormalities, reduced growth, increased mortality and
mutagenic effects in humans. The trace metals burden in the environment can be generally reflect by the levels of trace elements in water, the amount of metals ingested through water is of extreme importance in risk assessment to human health.\textsuperscript{68}

WHO (1993), In establishing guidelines for drinking water to protect public health, World Health Organisation applied the following definition: A guideline value represents the concentration of a constituent that does not result in any significant risk to health of the consumer over a lifetime of consumption. Although this guideline value provides a maximum level of a contaminant that may not cause any public health concern even following lifetime exposure, it does not implicate a green light for pollution of drinking water to the recommended guideline level. It must be recognized that, because water is essential to sustain life, a continuous effort should be made to maintain water quality at the highest possible level. The setting of standards might be influenced by national priorities and economic considerations and thus the conclusion on whether the health benefit of setting a specific standard justifies the costs involved is a matter of each individual country.\textsuperscript{69}

Nsanze et al., (1999) in their study reveal that the evolution of directives and regulations related to public health matters is not controlled only by toxicological or epidemiological findings. Economic interests, socio-cultural characteristics, hygiene practices, public awareness and sensitivity and technological development have always been as important as scientific evidence in the establishment of regulations related to public health protection.\textsuperscript{70}

Leeuwen (2000) in his study examined and observed that the whole human population needs drinking water for sustaining life and so the provision of a safe water
supply is a high priority issue for safeguarding the health and well being of humans. The production of adequate and safe drinking water is the most important factor contributing to a decrease in mortality and morbidity. To assure consumers that drinking water is safe and can be consumed without any risk, guidelines or standards have been set, giving maximum allow- able concentrations for compounds in drinking water below which no significant health risk is encountered.\textsuperscript{71}

Guler (2007) in his study revealed that standards have been developed by international, national and non-governmental organizations to define a quality of water that is safe and acceptable to consumers. Most of these standards set limits for physical parameters, chemical constituents and microorganisms that are dangerous and potentially hazardous to consumers.\textsuperscript{72}

Marsh (1995) in his study stated that population-based verbal autopsy studies in five of these squatter communities measured an under 5-year-old mortality rate of 100 deaths per 1000 live births; water borne diseases were the primary cause of 39% of these deaths.\textsuperscript{73}

CONCLUSION

In this chapter, all the earlier studies dealing with the packaged drinking water have been analysed. There is no particular study regarding awareness and attitudes of packaged drinking water of consumers in the southern districts of Tamil Nadu. Hence, the researcher has made this attempt for the present study.
REFERENCES


