The Effect of Handling Practices on the Quality of Sachet Water Consumed by Households in Nsukka Zone

By

Mberekpe, P.B (Mrs)
priscillamberekpe@gmail.com
GSM number 08035312600
Department of Home Economics Education
School of Vocational Education, Federal College of Education (Tech) Potiskum Yobe State
And
Dr (Mrs) Eze, N. M
ezengozi4real@yahoo.com
(Home Economics Education option)
Department of Vocational Teacher Education, University of Nigeria, Nsukka

ABSTRACT

This study ascertained the effect of handling practices on the quality of various sachets water consumed by households in Nsukka zone of Enugu State. Two research questions guided the study. Experimental design was used. Four brands of sachet water were randomly selected by balloting from seventeen brands identified in the zone. The water samples were stored at two storage environment (indoor and refrigeration) and the time durations were day one, 2weeks, 5weeks and 8weeks respectively. The four sample brands were code as MCW; JIW; DOW; and ETW. The samples of water were examined in both sensory and microbial count using standard analytical methods before they were stored in their storage environments and assessed at the treatment time durations respectively. At each treatment time duration, 48 samples of water were analzed. The findings showed that, there were no significant difference at ($p<0.05$) in the mean values of the four brands of sachet water at indoor storage environment for odour and for taste but there were significant difference at ($p<0.05$) in the four brands at refrigeration environment for Odour and for Taste. There were also significant difference at ($p<0.05$) in the mean value of coliform. Similarly, mould count also had significant difference at ($p<0.05$) in their mean values. From the findings, it was established that all the brands of sachet water produced in the zone had E.coli at day one, which is an indication of fecal contamination and refrigeration had the best taste and odour at 2weeks and very minute microbial content at 8 weeks of storage. The paper further suggested that sachet water shouldn't be stored beyond two weeks after production.

Key words: Handling, Practices, Quality, Sachet

Introduction

Water is very important to the body and it's highly demanded in other aspects of life. However, it is scarce in most parts of the country. It has no calorific value and still the cells, tissues, organs and all body processes and functions requires water. Water comprises more than sixty percent (60%) of the total human body (Ifeanacho, 2009). Ekairia and Iroanya, (2005) stated that water is an abundant and essential natural resource that is for the sustenance of human life. It is a vital constituent of all forms of life which occupies about 70% of the earth's surface. Similarly, Egboh and Emeshili (2007) stated that water is an important component of raw materials used in the processing of foods in industries and other domestic activities such as drinking, cooking, bathing

and general sanitation such as laundry, flushing of water system closets and other household chores, yet much of the world's population have scarcity of good drinking water.

Most of the water consumed in Nigeria is obtained from rain water, lakes, rivers, streams and ground water – such as boreholes and private wells which do not always produce pure water due to the presence of different contaminants (Okeri, Mmeremikwu and Ifeadi, 2008). The ground water percolates in boreholes and private wells. The authors further stated that the water obtained from these sources is subjected to various treatments by different manufacturing companies before packaging for sales or use in other manufacturing processes. Sachet water, one of the water consumed by households in Nsukka zone may not be sterile. According to Akunyili (2003), the inability of government to consistently provide potable (safe) drinking water contributed to the proliferation of the so called "Pure Water" (sachet water) manufacture in Nigeria. The author further stated that access to safe water affects adequate sanitation which in turn drives the risk of water borne diseases especially in poor urban communities.

Many people especially homes, schools, hospitals among others have turned to packaged water as an alternative to public tap water, believing that it is the best and safe source of water. Likewise, some households in Nsukka zone depend on sachet water as their source of drinking water. Packaged water either bottled or sachet like any other food product must be processed and packaged under aseptic conditions. Nwachukwu and Emeruem (2007) defined sachet water as any water that is in sealed plastic and distributed or offered for sale and intended for human consumption. The fact is that, sachet water may not be sterile and so water borne diseases such as dysentery, gastroenteritis, cholera, typhoid fever among others may affect members of the households.

Sachet water is widely available in both developed and developing countries (Dada, 2008). Consumers have many reasons for purchasing sachet water. Nwachukwu and Emeruem (2007) also noted that the reasons include taste, conveniences, price and safety. Apart from these, the duration and length of time the water can remain safe before it goes bad has been of great concern. The handling practice of water is all about the keeping quality or the durability of this water when it is stored beyond its immediate consumption. Miffin (2009), viewed handling as the way in which something is taken care of: the management of something or somebody. Brainyquote (2009) also looked at Practice as a frequently repeated or customary action, habitual performance; a succession of acts of a similar kind, usage; habit; or custom. Packaged water in plastic containers and polythene may contain some micro organisms, which are normally of little or no public health significance which may grow to higher level when period of storage has exceeded time frame (World Health Organization, 2000).

Studies carried out by Dibua, Esimone and Ndianefo (2007) on sachet water consumed by University of Nigeria Nsukka and its environment have shown that these water do not meet neither the NAFDAC (2004) nor World Health Organization (2003) standard. Sachet water whose production lacks proper purification and thermal sterilization increases their susceptibility to contamination by both bacterial flora, exogenous contaminating microbes, as well as a variety of other contaminants including mineral salts, organic pollutants, heavy metals and radioactive residues (Dibua, Esimone and Ndianefo, (2007). The state of water may increase the contamination of these products, when not properly kept and handled during the period of storage. Sachet water is one of the sources of drinking water for people of Nsukka zone; hence the need to study the effect of handling practices on the quality of sachet water. The findings of the study will be of

immense benefit to humanity, most especially to parents, children, home makers, teachers of home economics, community members, students and the entire populace of the nation, as this will provide them with information that will help them in the handling or keeping practices of sachet water.

Purpose of the Study

The main objective of the study was to determine the effect of handling practices on the quality of various sachet water consumed by households in Nsukka zone. Specifically, the study sought to:

1. Determine the effect of handling practices on odour and taste of the four brands of sachet water consumed by households in Nsukka zone
2. Identify the effect of handling practices on micro organism content of the four brands of sachet water consumed by households in Nsukka zone.

Research Questions

The study sought answers to the following research questions:

1. What is the effect of handling practices on the odour and taste of the four brands of sachet water, consumed by households in Nsukka zone?
2. What is the effect of handling practices on the micro organisms content of the four brands of sachet water, consumed by households in Nsukka zone?

Methodology

Area of the study: The study was carried out in Nsukka zone of Enugu state of Nigeria. Four brands of sachet water were used for the study, which include MC table water, Jives table water, De Occasion table water, Ecaison table water

Design of the study: The study was conducted using experimental research design which involves both sensory evaluation and laboratory-based in-vitro studies. This laboratory- Based in-vitro studies enables the researcher to examine the presence of specific variables (micro organisms: coliform and mould) in the sachet water samples using reagents under controlled environment. Also the study made use of sensory evaluation to carry out the sensory test such as taste and odour which cannot be carried out in the laboratory.

Population for the study: The population of the study involved the seventeen (17) brands of sachet water identified in the zone. The water brands include MC table water, Jives table water, De Occasion table water, Ecaison table water, Lion table water, Assured table water. Aqua Rapha table water, Ngene table water, Trans table water, O'gala table water, Kachel table water, Zeroth table water, Mount Calvary table water, Fidema table water, Pat Blessed table water, Rock Tama table water, and Add More table water. Aqua Rapha table water, Ngene table water, Trans table water, and zeroth table water are produced outside the zone,

while all others are produced within the zone. The four brands of sachet water selected from the seventeen (17) brands include: MC table water, Jives table water, De Occasion table water and Ecaison table water. These brands were coded MCW, JIW, DOW, ETW.

Sample for the study: A random sampling technique was used to select four brands of sachet water and this was done by balloting from the seventeen brands of sachet water available in the zone. Fourty-two (42) samples of sachet water were collected from each of the four brands selected for the experiment, bringing the samples to one hundred and sixty-eight (168) samples.

Instrument for data collection: The following instruments were used for data collection. For the physical properties, odour and taste were observed through sensory evaluation by a ten (10) man trained panel using 9- point hedonic scale rating score sheet.

A 9- point hedonic rating scale was formulated in two categories for odour and taste as follows:

Taste

Tasteless 9; Slightly tasty 8; Moderately tasty 7; Very tasty 6;

Extremely tasty 5; Slightly sour 4; Moderately sour 3; Very sour 2;

Extremely sour 1.

Odour

Odourless 9; Slightly pleasing 8; Moderately Pleasing 7; Very pleasing 6;

Extremely Pleasing 5; Slightly offensive 4; Moderately offensive 3; Very offensive 2; Extremely offensive 1;

B. The microbial properties were done using the most probable number (MPN) count of coliform organisms in samples. The MPN procedure is a multiple-tube dilution method using nutrient-rich media which is applicable to all types of microbiological organisms. The organisms looked out for were: Coliform test (*E.coli*), Mould count (f*ungi*). In this MPN method the examination starts with the presumptive *coliform* test, in which measured volumes (10ml or more) of the samples are inoculated into a series of five or more tubes containing a suitable liquid differential medium of lactose. After incubation for 37^{o}C for an appropriate time of 48hours, the tubes are examined for acid and / or gas production. The presence of acid or gas indicates positive reaction caused by some other organism or combination of organisms. The presumption that the positive reaction is caused by *coliform* organisms will therefore be confirmed by additional test with differential media, incubating at a temperature of 35-44^{o}C for 48hours.

Data collection Technique: The twenty-four (24) water samples were initially tested for control (A) and then the rest (144) water samples were divided into two storage environments namely: (i) indoor (that is kept in the room); (ii) refrigerating storage. Subsequently, the water samples from the various storage environments were tested at 2weeks (B); 5weeks (C) and 8weeks (D) formed the experimental group. Fourty-eight (48) samples (6 each from the four brands) from the two storage environments are used at each experimental period for both sensory and microbiological examination.

For the sensory evaluation:

Thirty-two (32) samples (4 each from the four brands) from the two storage environments are used at each experimental period for the sensory examination by the ten (10) man panel using the 9- point hedonic rating scale designed above.

For microbial evaluation: The microbiological examination of water was conducted on Coliform *(E.coli*) and Mould organisms in the samples. The MPN procedure used is a multiple- tube dilution method using nutrient rich media and the media used are MacConkey Agar and Ssbourand 4% Glucose Agar.

Media Preparation for coliform and total viable count determination

Sabourand Agar Preparation: Sabourand 4% Glucose Agar was prepared according to the manufacturer's prescription, which says 65g of Sabourand glucose agar should be added to 1litre of distilled water. Since 40mls of the agar media is to used for each sample of water, therefore 40mls x 12samples = 480mls of media.

- Thus 32.5g Sabourand glucose agar was added to 500ml of distilled water.
- Then the media was put into the autoclave to heat to a temperature of 121^{o}c and then allowed to remain in the autoclave for 15minutes.
- Then the media is allowed to cool (warm state).

For colform determination:

Coliform determination was done using 40ml prepared sabourand agar and 0.1ml of water sample was poured into a petri dish and then incubated at 37^{o}c for 24 hrs and then, the colonies were counted on completion of the incubation period. This was done for the four brands of water samples at the experimental period.

Media Preparation for mould count determination

MacConkey Agar Preparation: Mac Conkey agar was also prepared according to the manufacturer's prescription, which says 52g of Mac Conkey agar should be added to 1litre of distilled water. Since 40mls of the agar media will be used for each sample of water, therefore 40mls x 12samples = 480mls of media.

- Thus 26g of Mac Conkey agar was added to 500ml of distilled water.
- Then, the media was put into the autoclave to heat to a temperature of 121^{o}c and then allowed to remain in the autoclave for 15minutes.
- Then the media is allowed to cool (warm state).

For mould (fungi) determination:

The mould determination was also done using 40ml prepared MacConkey agar media and 0.1ml of water sample was poured into a Petri dish and then incubated at 35oc for 48hrs in an incubator. The colonies were counted on completion of the incubation period. This was also done for the four brands of water samples at the experimental period.

Data Analysis Technique: Mean was used for answering research questions 1 and 2. The mean of the data was compared using Least Significance Difference (LSD) at 0.05 level of significant. Mean was expressed as Mean ±SD, where SD is the standard deviation.

Findings: The following findings were made

1. Effect of handling practices on odour and taste of sachet water consumed by households in Nsukka zone is as follows in table 1 and 2 below:

Table 1: **Sensory Evaluation Scores of Effect of Handling Practices on odour of Sachet water**

Storage methods	Time duration	Brands MCW	JIW	DOW	ETW
	A(day 1)	6.9 ± 2.13^{a}	7.5 ± 2.42^{b}	7.2 ± 1.93^{c}	7.9 ± 1.95^{d}
	B(2wks)	7.4 ± 1.96^{a}	7.4 ± 2.22^{b}	7.9 ± 1.10^{c}	7.0 ± 1.82^{d}
Indoor	C(5wks)	7.5 ± 2.32^{a}	7.3 ± 2.11^{b}	7.5 ± 1.90^{c}	7.3 ± 2.00^{d}
	D(8wks)	7.8 ± 1.48^{a}	7.1 ± 2.02^{b}	6.9 ± 2.28^{c}	7.1 ± 2.42^{d}
Refrigeration	A(day 1)	6.9±2.13	7.5±2.42	7.2±1.93	7.9±1.66
	B(2wks)	8.2±1.23*	7.9±1.66	8.2±1.62	8.3±0.82
	C(5wks)	3.8±2.44*	3.8± 2.04*	3.7±1.83*	3.4±2.68*
	D(8wks)	2.4±2.07*	1.8±1.23*	1.6±0.97*	1.7±0.95*

*. The mean difference is significant at the 0.05 level.

With the indoor storage in **table 1**, there were no significant differences ($p<0.05$) between the odour of MCW, JIW, DOW and ETW stored at the four specified time durations. There were also significant differences ($p<0.05$) between the odour of MCW at A (day one) and C (5wks), A (day one) and D (8wks), B (2wks) and C (5wks), and B (2wks) and D (8wks). For the other brands of packaged water sampled, there was no significant difference ($p<0.05$) only between A (day one) and B (2wks) at refrigerating storage environment.

Table 2: **Sensory Evaluation Scores of Effect of Handling Practices on Taste of Sachet water**

Storage environment	Time duration	Brand MCW	JIW	DOW	ETW
	A(day 1)	7.4 ± 1.65^{a}	7.8 ± 1.55^{b}	7.9 ± 0.99^{c}	7.9 ± 0.80^{d}
	B(2wks)	7.5 ± 1.43^{a}	7.8 ± 1.69^{b}	7.7 ± 1.15^{c}	7.7 ± 0.95^{d}
Indoor	C(5wks)	7.6 ± 0.97^{a}	7.4±2.01*	7.6 ± 0.84^{c}	7.7 ± 1.49^{d}
	D(8wks)	8.0 ± 0.82^{a}	7.7±1.87*	7.2 ± 1.87^{c}	7.4 ± 1.35^{d}
Refrigeration	A(day 1)	7.4±1.65	7.8±1.55	7.9±0.99	7.9±0.88

	B(2wks)	6.9±1.97	7.5±0.97	7.1±2.02	7.9±0.99
	C(5wks)	4.6±1.90*	5.7± 1.95*	5.5±2.17*	4.5±2.75*
	D(8wks)	3.0±1.41*	2.9±1.66*	2.9±1.79*	2.7±1.83*

* The mean difference is significant at the 0.05 level.

In **table 2,** there were no significant difference ($p<0.05$) between the tastes of MCW, DOW and ETW at the four specified time duration, while there were significant difference in JIW at C (5wks) and D (8wks) when stored indoor. For all the brands in refrigeration, the tastes of the water were slightly bad in the C (5wks) and D (8wks) of storage, and that for all the brands sampled only water stored for A (one day) and B (2wks) showed no significant difference ($p<0.05$) in taste.

2. Effect of handling practices on micro-organisms are as follows in tables 3 and 4 below:

Table 3: **Effect of handling practices on micro-organism (COLIFORM) count**

		Brand			
Storage Environment	Time duration	MCW	JIW	DOW	ETW
Indoor	A(day 1)	6.0 ± 0.00^{a}	6.0 ± 2.83^{b}	5.0 ± 0.00^{c}	12.0 ± 0.00^{d}
	B(2wks)	8.0 ± 0.00^{a}	28.0±0.00*	6.0 ± 2.83^{c}	14.0±0.00*
	C(5wks)	22.0±0.00*	34.0±2.83*	24.0±5.66*	20.0±0.00*
	D(8wks)	27.0±1.41*	46.0±2.83*	28.0±0.00*	27.0±1.41*
Refrigeration	A(day 1)	6.0±0.00*	6.0±0.00*	5.0±0.00*	14.0±0.00*
	B(2wks)	0.0 ± 0.00^{a}	0.0 ± 0.00^{b}	0.0 ± 0.00^{c}	0.0 ± 0.00^{d}
	C(5wks)	2.0±0.00*	7.0±0.00*	0.0 ± 0.00^{c}	3.0±1.41*
	D(8wks)	5.0±1.41*	16.0±0.00*	7.0±1.41*	7.0±0.00*

*The mean difference is Significance at 0.05 level

In **table 3**, there were significant differences ($p<0.05$) between the coliforms of JIW and ETW stored at, B (2wks), C (5wks) and D (8wks). There were no significant differences ($p<0.05$) in C (5wks) and D (8wks) of DOW and MCW at indoor. There were also significant differences at ($p<0.05$) among the mean *coliform* of MCW, JIW, DOW and ETW stored for A (one day), B (2wks), C (5wks) and D (8wks) respectively in refrigerating environment.

Table 4: **Effect of Handling Practices on micro-organisms (MOULD) of Sachet water**

		Brand			
Storage Environment	Time duration	MCW	JIW	DOW	ETW
	A(day 1)	0.0 ± 0.00^{a}	0.0 ± 0.00^{b}	0.0 ± 0.00^{c}	0.0 ± 0.00^{d}
	B(2wks)	32.0±2.83*	0.0 ± 0.00^{b}	0.0 ± 0.00^{c}	0.0 ± 0.00^{d}
Indoor	C(5wks)	37.0±1.41*	0.0 ± 0.00^{b}	2.0±1.41*	0.0 ± 0.00^{d}
	D(8wks)	60.0±0.00*	12.0±5.66*	4.0±1.41*	6.0±1.41*
Refrigeration	A(day 1)	0.0 ± 0.00^{a}	0.0 ± 0.00^{b}	0.0 ± 0.00^{c}	0.0 ± 0.00^{d}
	B(2wks)	0.0 ± 0.00^{a}	0.0 ± 0.00^{b}	2.0± 0.00*	0.0 ± 0.00^{d}
	C(5wks)	6.0±2.83*	0.0 ± 0.00^{b}	4.0±1.41*	0.0 ± 0.00^{d}
	D(8wks)	7.5±0.70*	2.0±1.41*	8.0±1.41*	10.0±2.83*

*. The mean difference is significant at the 0.05 level.

In table 4, there were significant difference ($p<0.05$) between the mould count of MCW and DOW at C (5wks) and D (8wks), while JIW and ETW also showed that, there were significant difference ($p<0.05$) in the mould count at D (8wks) when stored indoor. No mould count was observed in day one for all the brands of water sampled and stored in refrigerating environment. There were significant differences among the mould counts of DOW at the four specified time duration. Significant differences existed in the mould count of MCW at C (5wks) and D (8wks), while JIW and ETW were at the D (8th wks) of storage in refrigeration.

DISCUSSION

The odour of water sampled indoor had slight change as the experimental period lasted in all brands. Though, MCW had the best odour (slightly pleasing) followed by ETW, then JIW and lastly DOW (moderately pleasing). Looking at the table it was observed that MCW and DOW appreciated in odour, but at eight weeks the odour depreciated, while JIW and ETW deteriorated progressively as the storage period increased. When indoor mean values were compared with refrigeration mean values. It was also observed that, at the first two weeks, the water was still very good, but at five weeks the water samples had changed to slightly offensive, while at eight weeks it became pronounced. This observation is in accordance with Lorris and Potto (2002), who opined that refrigerating at $4^{o}C$ is an excellent way of preserving biological materials over a short period of time. Each water brand at 8weeks rated very low indicating that the odour of the water samples had deteriorated.

Likewise the taste of water samples slightly depreciated in JIW, DOW and ETW in table 2, while there was an appreciation of taste in MCW (slightly tasty) as the storage time increased in indoor, when the control was compared with the mean value at 8wks. Although, the control samples were not 100% taste free (moderately tasty). When the mean values of indoor were compared with mean values of refrigeration environment, it was observed to be similar to odour that all the brands had changed to extremely tasty at 5wks of storage. This observation agreed with Okeke (2009), who noted that long term storage is best achieved by cooling at constant temperature. And also with Bennie (2007), who stated that sachet water as a product has specific temperature conditions under which it must be kept and failure to do so can cause serious health problems. This revealed why the sachet water samples in refrigeration environment were tasty at five weeks of storage due to fluctuation in power supply in the country.

All brands of water sampled had coliform from day one. This result corresponded with the study conducted by Dibua, Esimone and Ndianefo (2007), which noted that the bacteriological indices of contamination detected from the majority of sachet water samples are neither indication that the 'pure water' available in the university environment do not meet the NAFDAC (2004) nor the WHO (2003) standard and so may not be suitable for drinking purposes. The study conducted by Ekpo and Eddy (2005), at Akwa Ibom state, on the assessment of the quality of sachet and bottled water, also corresponded with the present study, on its findings on total coliform isolation. The coliform mean values increased in all the water sampled indoor as the storage period continued, though, jives water had the highest coliform count when stored indoor. On comparison of the two storage environments, it was noticed that all brands of water sampled in refrigeration environment had a very low coliform count at eight week of storage. Meanwhile, the mean values of coliform count of all brands of sachet water at refrigeration were at zero at 2wks of storage. MCW, JIW and ETW were noticed to have had coliform at the 5^{th} wk and continued, while DOW had coliform count at the 8^{th} week of storage.

With the mould count, all brands of water sampled as control were free of mould contamination at day one (A). However, as the storage duration continued *Cladosporium sphaerosperum spp, Curvularia lunata spp,* and *Cladosporium macrocarpum spp* were found in the two storage environments of the sampled water brands. Thus, comparing the two storage environments, it was noted that refrigeration environment had the least mould infestation at four specified time duration. The involvement of mould in this water samples may have occurred as a result of long keeping time, which agreed with Adofo (2009), that water kept enclosed for a prolonged period allows anaerobic algae and other microbes to grow in it, thereby making it unsafe and unfit for potable use.

Taking a more critical look at the microbial content of the sampled water brands at the two different storage environment and at four specified time duration, it was observed that, micro organisms content of refrigeration water samples had the least count. This observation agreed with Swiss Association for Nutrition (2009) which stated that, refrigeration occurs at temperature between -1^{o}C to + 8^{o}C, reactions leading to product spoilage are slowed down under refrigerating temperature and microbial proliferation is reduced. This was due to the fluctuation of power supply in the nation as the experiment was conducted using normal family situation and so no alternative power source was supplied. With this the result agreed with Dada (2009) noted that temperature is a major factor in determining the keeping quality of sachet water as high temperature influences the re-growth potentials of micro organisms. Similarly, Wright (2009) stated that, it is only when a product is kept at a constant temperature that has no extremely highs or lows, that would keep its quality. Looking at the possible reaction between the polythene bags and water components, the findings agreed with Naked Scientist Discussion forum (2009), who opined that the container in which water is kept would limit the keeping quality of the water, when the container leaks some sort of chemicals into it and the keeping quality of tap water is a few days, while filtered water is considerably less than this. Finally, Weaser (2010) noted that fridges contain hydrofluorocarbon (HFC) gases as coolants and gases such as chlorofluorocarbons escapes to the environment in normal use and maintenance of fridges and these gases depletes the ozone layer. If these gases can deplete the ozone layer gradually, it then means, that the gases can react with any biological product in the fridge, thereby affecting its organoleptic and physical characteristics when kept for prolong period.

Conclusion

The analysis of result showed that at $p<0.05$, refrigeration environment had significant effect on microbial content and at 2weeks taste and odour over indoor storage in all the brands of sachet water considered in this study. Refrigeration environment had greater advantage over indoor in micro-organisms content of the four brands of sachet water at three specified time durations. However, indoor storage had advantage over refrigeration at two specified time duration (5weeks and 8weeks) respectively.

Recommendation

1) The storage duration of sachet water should not exceed 14 days (2weeks) of production at all conditions of storage for the purpose of consumer safety.

2) Ideal handling practices should be taught to the people concerned with sachet water production, distribution and consumption in the zone and the nation at large. This may be done by organizing seminars and workshops to sachet producers, distributors and consumers on the ethics of production and best ways of handling.

3) Home Economics programmes with particular reference to Foods and Nutrition curriculum should incorporate the ideal handling practices of sachet water into the secondary school curriculum. This is because water is food and needs all attentions required to keep it safe for consumption in order to avoid contamination.

4) Research on Foods and Nutrition should also focus attention on water storage and consumption, as water borne diseases are transmitted through the consumption and utilization of water in the home. This happens when contaminated water is taken or used for bathing and other domestic chores.

References

Adofo, R (2009) How Safe is the Sachet "Pure Water"? Retrieved on the 15th may 2009 online

Akunyili, D.N. (2003). *The* Role of Pure Water' and Bottled Water Manufacturers in Nigeria. Retrieved on the 3rd of April 2009 fromhttp://wedc.iboro.ac.uk/conferences/pdfs/29/Akunyili.pd

Bennie, J (2007). Food and Drug Board raises alarm----over sachet water handling: Ghanaian Chronicle online. Retrieved on the 24th of July 2010 from http://news2/285956/1/modernghana.com/food-and-drugs-board-raises-alarmover-handling-of-,html

Dada, A. C. (2008). Sachet Water Phenomenon in Nigeria- Assessment of the potential health impacts in Lagos State, Nigeria. Retrieved from *African Journal Microbiology Research* 3(1):015-021

Dada, A. C (2009). Towards a Successful Packaged Water Regulation in Nigeria. Retrieved on the 22nd April, 2010 from http;//www.*academicjournals*.org/sre

Dibua, U. E; Esimone, C. O; & Ndianefo, P. C (2007). Microbiological and Physical Characteristics of sachet water samples marketed in Nsukka campus of the University of Nigeria in *Bio – Research a publication of the Faculty of Biological Sciences*, UNN 5 (1): 189-193.

Egboh, S.H.O & Emeshili, E. M. (2007), Physico-Chemical Characteristics of River Ethiope Source in Umuaja, Delta State *in journal of chemical society of Nigeria*, Benin city, Edo state: Seevon publishers, 32(2):72- 76.

Ekaria, J & Iroanya, R. O (2005), Analysis of Water Quality Parameters of Some Selected Wells in Yobe State in *Journal of Academic Publication and Research Association of Nigeria (APRAN)* 1(1):46-47.

Ekpo, A. S. & Eddy, N. O (2005) Assessment of the Quality of Sachet and Bottled water in Akwa Ibom state south eastern Nigeria. *Proceeding of the 28th International Conference of the Chemical Society of Nigeria.* 2(2) :363-366

Ifeanacho, M. O (2009), Fundamental Nutrition. Port Hacourt: masterpiece publisher 83-86.

Loris, J & Potto, P (2002). Collection and Preservation of Samples. Retrieved on the 6th of October 2010 from *http://www.loris.conservation.org/database/wild_survey/necropsy/sample_collection.html*

Miffin, H (2009). The American Herritage Dictionary of the English Language. Retrieved on the 24th of July 2010 from http://dictionary.reference.com/browse/handling

Naked Scientist Discussion Forum (2009). Shelf Life of Water. Retrieved on the 22nd of April, 2010 from http://wwe.google.co/Nakedscientistdiscussionforum.htm

Nwachukwu, C & Emeruem, C.M (2007). Presence of Antibiotic Resistant Bacteria in Sachet water Produced and Sold in the Eastern Nigeria. Retrieved from *Research Journal of Microbiology* 2(10): 782 - 786.

Okeke, S. U. N. (2009). Home Economics for schools and colleges. Onitsha: AFP Africana first publishers.

Okeri, H. A.; Mmeremikwu, A. C & Ifeadi, A.N (2008). Determination of Trace Metals Presence in Drinking Water and Fruit Juice in Benin City. *Journal of Applied Bioscience.* 13. Retrieved from www-bioscience .elewa.org.

Swiss Association for Nutrition (SAN 2009). Preserving, Transporting and Storing Foods Retrieved on 9th October 2010 from http://www.healthandage.com/preserving-transporting-and-storing-food

Weaser. G. (2010). Supermarket fridges as polluting as their plastic bags. Retrieved on the 6th of October 2010 from www//guardian.co.uk/business/2010/feb/01/supermarket_fridges_pollution (Environmental Investigation Agency)

Wikipedia, the free encyclopedia (2009). Definition of practice. Retrieved on the 24th of July 2010 from http://en.wikipedia.org/wiki/practice(learning-method).htm

World Health Organization (2000). Guidelines for Drinking Water Quality –Training Pack. Retrieved on 5th may 2009 from **http://127.0.0.1/gsd1?e=d.0whowater--000--0-0--01-0st0--0-10lef--1**

Wright, A. (2009). Introduction and Factors affecting Storage. Retrieved on the 10th of April, 2010 from http://www.waltonfeed.com/blog/show/article_id/163