Resources and Environment 2012, 2(4): 164-168
DOI: 10.5923/j.re.20120204.05

Assessment of Microbiological Quality of Water Wells in Rural Properties of the City of West of Santa Catarina, Brazil

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Abstract Due to the large consumption of water wells and springs in rural properties in the far west region of Santa Catarina and illnesses related to consumption of contaminated water, this study was to evaluate the microbiological quality of water wells in rural properties in the far west of Santa Catarina, Brazil. Thus, this study can be used as a tool to discuss the current state of the wells that supply farms in the far west of Santa Catarina, since it is necessary to introduce orientation programs for consumers of untreated , for the most part unaware of these basic methods for maintaining the quality of drinking water. The research was conducted with Company of Agricultural Research and Rural Extension of Santa Catarina SA (EPAGRI) of Sao Miguel do Oeste, SC. We collected samples from 70 wells from 07 city in the region west of Santa Catarina from May 2011 to February 2012, and collected three samples per well evaluated in different periods. Samples were collected by technical EPAGRI of each municipality participating in the study and subsequently transported and analyzed in the Research Laboratory and Diagnostic Microbiology of the University of West of Santa Catarina. Towards assess the quality of water was used for faecal technique for Multiple Tube Fermentation and heterotrophic bacterial count technique pour plate with standard agar for count established by the Normative Instruction No. 62, August 26, 2003 the Ministry of Agriculture , Livestock and Supply. In the laboratory, were applied to wells of a user questionnaire for their perception of water quality. Of the 70 wells analysed, 67 (95.71%) were considered unsuitable for human consumption, according Decree in 2914 to 12 December 2011 the ministry of health. The average amount of total coliform samples found unsuitable (199 samples from 67 wells) was 366.09 MPN / 100 ml, ranging from 265.98 to 527.1 MPN /100 mL. Since the average amount of faecal coliform found in these samples (those considered unfit) was 62. 34 MPN /100 mL ranging from 12.73 to 105.5 MPN /100 mL. For the average score heterotrophic microorganisms in the samples was unsuitable 1386 CFU / ml, ranging from 836 to 2234 CFU / ml. Although the data found in laboratory tests, the questionnaires showed that 82.88% of owners who use water classified as good or excellent quality, and less than half (42.84%) filter or boil water before consuming it .Thus, we can see that it is extremely important that preventive measures are taken for the preservation of the sources and improving water quality in the region, since most water wells are unfit for human consumption and which further aggravates these results is the users' perception about the quality, which contributes to the lack of concern with basic care to avoid such a problem.

Keywords Water. Coliform. Protective Factors

1. Introduction

The access to potable water and sanitation are basic human needs and essential for the health and well being of the human population. Thus, water quality becomes very mechanisms by which microorganisms from faeces may be present in the water. Among the factors that contribute to cause contamination of water are: the final destination of important, especially because it may contain contaminated as pathogens and cause various waterborne diseases.

Epidemiological studies show a high risk of contracting gastrointestinal and respiratory illnesses after contact with water containing high concentrations of coliform[1].

This problem can be from several factors that can compromise the quality of water, because there are severald omestic and industrial sewage, the improper disposal of municipal solid waste and industrial use of old wells, improperly sealed and near sources of contamination, as drains and areas occupied by grazing animals[2].

Some work in the extreme west of Santa Catarina showed that this region has high contamination of water sources[5-8]

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Published online at http://journal.sapub.org/re

Moreover, this problem is seen mainly in rural areas, since Silva et al.[7] undertook a study within the city of Descanso-SC, performed that 98.6% of the samples were unfit for consumption.

Bacterial contamination of drinking water is a major public health problems in the world, because this water can be an important vehicle of diarrheal diseases of infectious nature, which makes it necessary to evaluate the microbiological quality[2].

Thereby, monitoring the health conditions of drinking water is done through laboratory testing for the coliform group. The coliforms are widely used as microbiological parameters indicating faecal contamination while total coliforms include coliform and environmental species that can serve as a parameter to provide basic information on water quality[9].

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Thus, this study aims to evaluate the microbiological quality of water consumed by the rural population of the western tip of the state of Santa Catarina, Brazil, since these sites are not usually performed analyzes of water, because most of the population believes that drinking water is of excellent quality, being from wells and without chemical treatment. Furthermore, consumers often associate the water used as "raw water", since they have no kind of treatment, whereas no need to evaluate the quality of drinking water.

2. Materials and Methods

Samples were collected in 70 wells in seven municipalities in the west end of Santa Catarina, in the period November 2011 to February 2012 was collected three samples from each well (01 November, 01 December 2011 and 01 February 2012), totaling 208 samples, because in two wells in the last sampling (February 2012) was not possible to collect blood, since due to the scarcity of rainfall, the spring water had not evaluated.

The choice of cities to conduct this study was in accordance with the interests of the Regional Epagri of São Miguel do Oeste, SC, who helped collect samples and study the characteristics of the wells and users' perception.

Samples were collected with plastic bottles sterile, aseptic conditions and transported in coolers with ice in a temperature below 5 ℃ the Research Laboratory and Diagnostic Microbiology of the University of West of Santa Catarina to perform microbiological analysis.

Towards evaluate the microbiological quality of the samples were analyzed for total coliform, coliform and heterotrophic plate count according to methodology described in the American Public Health Association guidelines, and in accordance with Federal Decree 62, 26 August 2003 of Brazilian Ministry of Agriculture and Supply.[10]. Towards check the Most Probable Number (MPN) of total and faecal coliforms was used the technique of Multiple Tube Fermentation. The results were expressed as MPN/100ml. To calculate the means were considered negative results for coliforms (<3.0 MPN/ 100 ml) to zero and the maximum count (>1100 MPN/100 ml) and 1100 MPN /100 ml.

The heterotrophic bacteria count was performed using the pour plate technique, which were spread in 1 ml of the dilutions of 1 ml and 0.1 ml in sterile Petry plates and then added Plate Count Agar. These were incubated in bacteriological 36 ± 1℃ for 48 hours. The results were expressed as CFU / ml.

The characteristics of the wells were obtained by applying a questionnaire for the farmer responsible for each well was analysed in the period of sample collection.

3. Results and Discussion

The results of the 70 wells analyzed in the seven cities of the western of Santa Catarina, only three wells (4.28%) were considered for consumption as microbiological standards established by Decree 2914 of 12 December 2011 the Ministry of Health (MH)[11]. Of these three wells, two had only one sample collected in the absence of total coliforms and thermotolerant and with absence of these two groups of microorganisms.

According to this Decree (2914/2011), control of water quality, when detected in samples positive for total coliforms, even in presumptive tests, corrective actions should be adopted and new samples must be collected on successive days immediately by revealing satisfactory results. Thus, in this case fall within the two wells that had only one sample only coliforms

The only presence of total coliforms in the samples indicating environmental contamination by organic waste as the remains of leaves, stems, environmental microorganisms, because according Kilb et al.[12], bacteria belonging to the group of coliforms can also be found in natural environments such as soil water, vegetation, or surface, where its occurrence is not necessarily related to faecal contamination.

Thus, it is recommended that only those wells contaminated with total coliforms are assessed and preventive and corrective measures taken to solve these problems and made new analysis to ascertain the absence of these microorganisms.

In 67 of the wells with water deemed unsuitable for human consumption, was observed for total coliforms andthermotolerant at least one sample, but three wells that showed only total coliforms, but more than one sample collected, and therefore also considered unfit for consumption because as Annex I to decree 2914 of December 12, 2011[11], only one

sample among the samples examined in the month, can have positive results.

In the samples considered unsuitable for human consump tion the highest mean score were found for heterotrophic microorganisms, followed by total coliform and fecal coliform (Table 1).

Table 1. Count and average groups of microorganisms found in the waters unsuitable for human consumption from the 67 wells with contaminated water

Microorganisms	Maximum count	Minimum count	Average count
Heterotrophic microorganisms CFU/ml	836	2.2	1386
Total coliform MPN/100 ml	527.1	265.98	366.09
Faecal coliform MPN/100 ml	105.5	12.73	62.34

These results demonstrate the high amount of microorgan isms found in the waters assessed and reinforce previous studies in the extreme west of Santa Catarina, since other work such as Malheiros et al.[5] and Rodhen et al.[6] also found a large amount of samples with total and fecal coliforms in this region, which demonstrates that the far west region of Santa Catarina has the water used for human consumption with low microbiological quality.

Currently the data of water quality in the region of the western tip of Santa Catarina, Brazil, are very scarce, which hampers our discussions and comparisons in this study, because we have only old data. Anyway, such a problem and justifies the publication of our study.

Similar results are found worldwide, for example we can cite the work of Schets et al.[13] and Hong, Qiu, Liang[14] found that water used for human consumption contaminated by coliforms.

The contamination of water in rural properties were also found in São Paulo Amaral et al.[4] reported that 90% of water samples from sources, 90% and 96.7% of the reservoirs of drinking water, collected during the rainy season, and 83.3%, 96.7% and 90%, those collected in the same places respectively, during the dry season, were out of the microbiological standards for potable water for human consumption.

Also, Soto et al.[15] in Ibiúna / SP found in a study of shallow wells in rural public schools, 90% contamination with total coliforms and 82% with coliforms in their samples, pointing out that the problem is not isolated, and that mainly affects the countryside where the control of water quality in most cases is not performed.

The contamination by total coliforms only indicates the possibility of contamination by organic matter, because this group of microorganisms is used as a basic parameter of environmental contamination[14].

Considering the contamination with faecal coliforms indicate faecal contamination and the possible presence of pathogenic microorganisms of enteric origin, the results for the wells in this study show that they can be a risk to health of the population using that water for consumption, mainly because this water when consumed without prior treatment, can transmit several diseases of gastrointestinal origin[16].

Furthermore, according Levantesi et al.[17] several-fold water may carry pathogens, for example, *Salmonella* sp. resistant to antibiotics and these are spread by contaminated water therefore, that you can infect humans and animals, thus causing risk of difficulties in effective treatment and infection control.

Although in this study, only 14.28% (table 2) of people related water to diarrheal diseases, Yassin, Amr, Al-Najar[18] in a study conducted in the Gaza Strip between 2000 and 2006, diarrheal diseases were strongly correlated with water contamination by faecal coliforms. These data again show a very common problem, also reported by Amaral et al.[4], the lack of knowledge of consumers in relation to water, because most often associate the visual and organoleptic characterist ics as decisive in the quality of water consumed.

According to data from the questionnaires to the owners of the 70 wells analyzed, 33 (47.14%) of the springs were used only for human consumption, 24 (34.28%) used for human consumption and animal, 12 (17.14%) only for animal use, and one owner said he did not use water.

Another important result, particularly when compared with the results of the microbiological quality that the majority of respondents report that does not boiled or filtered water and before consuming it (Table 2). These results are concern because, according to Amaral et al.[4], it is observed that the water contamination in the farms is concern, since there is considerable risk in the occurrence of waterborne diseases, mainly because they believe that because well water is pure and natural without the risk of damage to health.

Table 2. Data (Value in percentage) from the questionnaire applied to those responsible for the well

Factors evaluated	Yes	Not
Boiling the water	31.42%	68.58%
Filtered water	11.42%	88.58 %
Clean the water tank	90.28%	9.72%
Presented diarrheal diseases	14.28%	85.72%

This idea of believing that consume good quality water was confirmed in our study, since only 4.27% classify water quality as great or very great, 12.85% and 82.88% as regular as excellent or good quality, demonstrating that the owners are often unaware of the true quality of water they consume.

For this situation to be resolved is an important work of public awareness of the risks that non-potable water may provide human health and also animal, nother very important factor to consider in water quality is to clean the reservoirs[19]. In the present study, most respondents said conducting the cleaning water reservoir (table 2), however between long periods in other words 42% of owners say they

clean the tank 1-2 times a year, 44% every 2 years, 4.28% every 5 years or more, and 10 % say they have never cleaned the reservoir.

These results demonstrate that although several campaign s are held to be performed periodically to clean the tanks, we still find a fault in relation to this factor, which reinforces the idea of a frequent monitoring by health professionals in the maintenance of these water sources.

In relation to vegetation strip 72.84% have 5 to 10m, 12.86% have from 11 to 49m, no owner has more than 50 meters of vegetation around their wells and 14.29% did not answer the question. Moreover, 84.28% of the wells have lid and have no other 15.71%. Although the wells have some protective factors such as riparian forest nearby cover, it appears that there are flaws in these, which favors the occurrence of contamination.

Please note that the wells evaluated according to the questionnaires had most riparian and / or reforestation around it, but in smaller area than that established by the normative instruction 13, 2009[20], which states that the area immediate protection should cover a radius of 15 meters in rural areas, if possible from his collection, which site should be fenced-Dindo prevented the entry of outsiders, animals or any pollutants, which was not observed in any of sources analyzed.

These results, are increasingly demonstrating the importa nce of maintaining protection factors near the springs and wells, because according to Amaral et al.[4] recommended as these are of great importance to the preservation of water quality, which highlights the need for an orientation given to the people who use these waters, in order to maintain its quality. These peo-searchers say they still charge the actual con-sumer to control the water quality is poor posture, since their knowledge about the risks that water can offer to health care is practically nonexistent.

5. Conclusions

The results found in this study showed that the majority of water used on farms in the west end of Santa Catarina, with the microbiological quality are changed, which becomes an even greater concern when comparing the results of microbiological analyzes with data obtained by applying the questionnaires, since 82.88% of consumers believed they were drinking good quality water.

Furthermore, the results suggest that the causes of microbiological contamination of the water may be due to the lack of protection factors close to the wells in the study.

Moreover, there is a need to target consumers of these waters, mainly because only filtered 31.42% 11.42% water and boiled before consuming it, which worsens the results, because the water when boiled filtered or decreases the number of microorganisms and consequently the risk of transmitting waterborne diseases.

The data in this study are a public health problem, since contaminated water can carry many pathogens and these may cause consumers to various waterborne diseases such as amebiasis, diarrhea, cholera, hepatitis A, etc.

Thus, we conclude that there is a need to develop ongoing programs of guidance for users of wells or springs, such as lack of technical information for the most part, which hinders the implementation of protective factors or sources of care also basic intake of water free of microorganisms.

ACKNOWLEDGEMENTS

We thank all the experts from the Agricultural Research and Rural Extension of Santa Catarina SA (EPAGRI) regional Sao Miguel West-SC for helping in this work by collecting water samples.

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