



Expert System Diagnosing Escherichia Coli (E-Coli) Bacteria in Refill Drinking Water with Certainty Factor Method

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ABSTRACT

Maybe drinking water that is bought and consumed looks clean and clear like drinking water in general, but behind the clean and clear drinking water, the community cannot know what is contained in it. Cheap and affordable prices may be one reason people choose refill water from existing drinking water depots. No matter where the drinking water comes from, the most important thing is that daily drinking needs are met. Many depots that have sprung up at this time do not include a letter from the local health office stating that drinking water is suitable for consumption. Expensive costs and very difficult affairs make drinking water depot owners ignorant of the most important things that must be owned.

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1. INTRODUCTION

Along with the increasing demand for drinking water at this time, many depots or places for refilling drinking water have sprung up. Sometimes many people do not know whether the water is suitable for consumption or not [1]. The reason is because the water that is consumed daily without going through the cooking or boiling process first.

Maybe the drinking water that is bought and consumed looks clean and clear like drinking water in general, but behind the clean and clear drinking water people cannot know what is contained in it [2]. Cheap and affordable prices may be one of the reasons people choose refilled water from existing drinking water depots. It doesn't matter where the drinking water comes from, the most important thing is that your daily drinking needs are met.

Many depots that have sprung up at this time do not include a letter from the local health office stating that the drinking water sold is fit for consumption [3] [4]. Expensive costs and very difficult affairs make the owners of drinking water depots ignore the most important things that actually must be owned.

One of the things that can threaten health through drinking water is the presence of Escherichia Coli (E-Coli) bacteria [5] [6]. To find out whether the drinking water that is consumed contains E-Coli bacteria is not easy, because its size is very small and invisible to the eye [7]. One of

the consequences that can be caused by E-Coli bacteria is abdominal pain, vomiting, diarrhea, high blood pressure, and even kidney disorders [8] [9].

Therefore, here the author wants to create an expert system designed to determine whether the drinking water consumed contains E-Coli bacteria or not.

An expert system is a system designed to imitate the knowledge of experts so that the system can complete the work as done by the expert [10] [11] [12]. One area of application of the Expert System is the diagnostic process that determines the causes observed by a system based on the symptoms that occur [13] [14].

In this study the author will use Certainty Factor as a method and implement it into an expert system. Certainty Factor (certainty factor) expresses belief in an event or fact based on evidence or expert judgment. Certainty Factor uses a value to assume the degree of confidence of an expert on a data [15] [16] [17].

Based on previous research entitled "Design of Expert System Applications to Identify Diseases in Watermelon Plants Using the Certainty Factor Method" (Dodi Harto, 2013), the authors get many references to conduct further research with different problems. Where the certainty factor method solves a problem with the concept of belief and disbelief. So that it can be seen whether the certainty factor method can also be used in solving other problems.

2. RESEARCH METHODS

Analysis is useful to determine software requirements and the needs of the expert system built. In this stage, the search and collection of data and knowledge needed by the expert system is carried out. So that in the end the results obtained from the analysis are in the form of a system whose structure can be well and clearly defined. The purpose of system analysis in the development of this expert system is to obtain various user and system needs, namely regarding input and output that must be provided by the user and required by the system. This process will be an input for the overall system design process. Fill in the list of rules based on a certain order and pattern. During the consultation process between the system and the user, the inference mechanism tests the rules one by one until the condition of the rules is true.

3. RESULTS AND DISCUSSION

Based on the results of consultations conducted with the BTKL (Environmental Health Engineering Agency) Medan city, there are several characteristics of drinking water contaminated with Escherichia Coli bacteria, including; Smells like sewer or mud, tastes bitter or tart on the tongue, is not clear or cloudy, slightly yellowish.

3.1 Analysis of the Application of Certainty Factor Methods in Expert Systems

After obtaining the characteristics of drinking water contaminated with Escherichia coli bacteria from BTKL (Environmental Health Engineering Agency), then questions were given to experts to get the MB (Measure of Belief) and MD (Measure of increased Disbelief) values for each characteristic of drinking water contaminated with Escherichia coli bacteria, as shown in table 3.1 below:

Table 1. Question

Feature Code	Question	Answer
C1	Does refilled drinking water "Smell like sewer or mud" ?	TY ST KY CY Y SY
C2	Does refill drinking water "Taste bitter or stinging on the tongue"?	TY ST KY CY Y SY
C3	Is the refill drinking water "Not clear or cloudy"?	TY ST KY CY Y SY
C4	Is the refill drinking water "A bit yellowish"?	TY ST KY CY Y SY

Feature Code	Question	Answer
C5	Is drinking water refill “Color changes in 2 days” ?	TY ST KY CY Y SY

When you want to answer a question, 6 (six) answers will be given, each of which has the following weight:

- a. TY (Not sure) : 0
- b. TT (Don't Know) : 0.2
- c. KY (Not sure) : 0.4
- d. CY (Quite Sure) : 0.6
- e. Y (Sure) : 0.8
- f. SY (Very Confident) : 1.0

After all the questions were answered, then the MB (Measure of Belief) and MD (Measure of increased Disbelief) values were obtained for each characteristic of refill drinking water contaminated with Escherichia coli bacteria as shown in table 2 below:

Table 1. MB (Measure of Belief) and MD (Measure of increased Disbelief) values

No	Code	Water Characteristics	MB Value	MD value
1	C1	Smells like sewer or mud	0.8	0.2
2	C2	Taste bitter or tingling on the tongue	0.8	0.2
3	C3	Not clear or cloudy	0.8	0.2
4	C4	Slightly yellowish	0.6	0.4
5	C5	Color change in 2 days	0.6	0.4

Based on the information on the characteristics of the water and the MB (Measure of Belief) and MD (Measure of increased Disbelief) values that have been obtained, in this case a production rule or rule base related to Escherichia Coli bacteria has been compiled, the rules are as follows:

IF smells like sewer or mud
 AND feels bitter or tingling on the tongue
 AND is not clear or cloudy
 AND is a bit yellowish
 AND color change in 2 days
 THEN contains Escherichia coli bacteria.

After that, the calculation is carried out using the certainty factor method formula. And here is the formula for the certainty factor method:

$$CF(H,E) = MB(H,E) - MD(H,E) \dots\dots\dots (1)$$

$$CF(H,E)_1 = CF(H)*CF(E) \dots\dots\dots (2)$$

$$CfcombineCF(H,E)_{1,2} = CF(H,E)_1 + CF(H,E)_2*(1CF(H,E)_1) \dots\dots\dots (3)$$

$$CfcombineCF(H,E)_{old3} = CF(H,E)_{old} + CF(H,E)_3*(1CF(H,E)_{old}) \dots\dots\dots (3)$$

Suppose the user chooses the answer to the question from the characteristics of refilled drinking water as follows:

- a. Smells like sewer or mud : very sure
- b. Taste bitter or tingling on the tongue : convinced
- c. Not clear or cloudy : convinced
- d. Slightly yellowish : pretty sure
- e. Color change in 2 days : not sure

4. CONCLUSION

After discussing the previous chapters, the conclusion is, to diagnose bacteria in refilled drinking water by determining the CF value of each characteristic of refilled drinking water containing Escherichia coli (e-coli) bacteria and diagnosing Escherichia coli bacteria by showing the value of the level of confidence.

The application of the certainty factor method is very suitable for use in expert systems to diagnose *Escherichia coli* bacteria in refilled drinking water, so that the results of the certainty level of *Escherichia coli* diagnosis can be known, which basically users of this application do not know whether the refilled drinking water to be consumed contains *Escherichia coli* bacteria. or not.

Certainty factor methods and visual basic.net 2008 programming can help to determine the presence of *Escherichia coli* bacteria in refilled drinking water based on the visible characteristics of refilled drinking water as well as a means of prevention so that water containing *Escherichia coli* bacteria is not consumed, so it is not consumed. cause disease.

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