Expert System Application for Identifying Formalin and Borax in Foods Using the Certainty Factor Method

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Abstract: Formalin and borax are additives that are widely used in food to be durable and not stale, the use of formalin and borax is not recommended for food because it can cause many diseases, especially cancer, to find out whether a food using formalin or borax can be examined using a system experts based on the characteristics of these foods in this case as a sample are meatballs which are one of the favorite types of food in Indonesia. The Certainty Factor method is one of the expert system methods that can be used to carry out checks based on facts on food and also the value of certainty given, testing obtained from using the certainty factor method can be used as a reference for consumers in choosing foods that are healthy and do not contain formalin or borax

Keywords: Certainty Factor, Expert System, Food and Expert System.

INTRODUCTION

The development of science and technology sped up in various aspects of life[1]. One of these aspects is the development of food and beverages that we consume daily. Today, along with the times that are supported by the rapid development of technology, all aspects of life are not immune from the influence of technology[2]–[4].

But the use of the technology is not supported by an intelligent brain that is often misused, technology and chemicals are often combined and create something that can simplify human life but at the same time can shorten human life itself[5]–[8].

In terms of food, for example, this is also supported by the role of women, currently women are born not only to take care of the household, but also become women who earn large or often called career women, so there is almost no time to prepare food for families, so it does not wonder if fast food is more chosen as one of the main alternatives for stomach fillers considering the taste of food served and the serving time is only minutes, so it doesn't drain much time. But unwittingly some types of fast food that are often consumed contain several types of hazardous ingredients[9], [10] that trigger the emergence of chronic diseases, such as: heart attack, insulin resistance, diabetes, and several other dangerous diseases[8], [11].

As consumers, they should also be smart in choosing food, because often producers do not include warning spots, do not include registration numbers, and even include "halal" markings even though they do not have a certificate and permit for halal inclusion, further tightening supervision of fast food on the market.

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Then there are also some fast food that have included warning spots, registration numbers, and "halal" marking, but after being investigated they still contain hazardous ingredients such as formalin, borax, trans fat which is known to be twice as dangerous as saturated fat, and other hazardous materials[12], [13]. This article examines more about what ingredients can be said to be harmful in food, how does the Food and Drug Supervisory Agency perform in determining the hazardous materials, and how to follow up if some foods containing ingredients have been found hazardous materials and what steps are taken to minimize the use of these hazardous materials to maintain consumers' health.

Seeing this impact, this article discusses and makes an application of an expert system to identify the content of formalin and borax in food. In drawing conclusions in the expert system in general the reasoning is Forward Chaining and Backward Chaining[14]–[17]. However, with the second use of reasoning, we cannot determine the value of trust in the hypothesis. So that the expert system can do reasoning as an expert even though in conditions of data uncertainty and to obtain a trust value in this case the author uses a method to complete the data using the Certainty Factor (CF) method[18]–[20]. The Certainty Factor method is a method that defines a measure of certainty for a fact or rule, to describe the level of expert confidence in the problem at hand, using Certainty Factor can describe the level of expert confidence.

METHODS

Expert System[21] is one branch of computer-based Artificial Intelligence that uses knowledge, facts, and reasoning techniques in solving problems, which usually can only be solved by an expert in a particular field. With this expert system, even ordinary people can solve the problem or just looking for an actual quality information can only be obtained with the help of experts in their field.

Expert systems will also help the activities of experts as experienced assistants and have assistants and have the knowledge needed[22], [23]. In its preparation, the expert system combines the rules of drawing conclusions with certain knowledge bases given by one or more experts in a particular field. The combination of these two things is stored in a computer, which is then used in the decision making process to solve certain problems.

The main objective of an expert system is not to replace the position of an expert or expert, but to share the knowledge and experience of an expert or expert in solving a problem[24], [25].

Certainty Factor (CF) is to accommodate the expert inexact reasoning proposed by Shortliffe and Buchamn in 1975. An expert (such as a doctor) often analyzes existing information with expressions such as "maybe", "most likely", "Almost certain". To accommodate this we use certanty factor (CF) to describe the level of expert confidence in the problem at hand.

Certainty Factor (CF) shows a measure of certainty about a fact or rule. Certainty Factor Prediction is as follows:

$CF [h, e] = MB [h, e] - MD [h, e]$ with

$CF [h, e]$: Certainty Factor

$MB [h, e]$: measure of trust in hypothesis h, if given evidence e (between 0 and 1).

$MD [h, e]$: a measure of distrust of evidence h, if given evidence e (between 0 and 1)
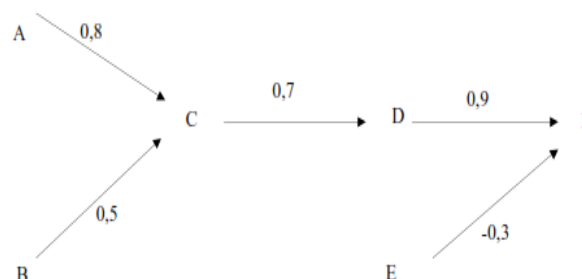

Figure 1: Certainty Factor Network

The stages of analysis of a system are carried out before the design stages are carried out. The purpose of applying the analysis of a system is to find out the reason why the system is needed, so that the functions contained in the system work optimally. One of the main elements that must be considered in this stage of system analysis is the software problem, because the software used must be in accordance with the problem to be solved.

The characteristics of foods containing formalin will be tested in general based on table 1 below:

Table 1: Characteristic Food with Formalin

No	Code	Criteria	Value
1	C1	Very springy	0.2
2	C2	Stay intact for 3 days	0.2
3	C3	Colors tend to be clean	0.4
4	C4	Pungent aroma	0.8
5	C5	Tends to be hard	0.5
6	C6	Rubbery	0.4
7	C7	Not stale for 5 days	0.6

The analysis of the expert system built is a rule that applies the certainty factor method, the certainty factor method is one method used to calculate the certainty factor in overcoming the difficulties of symptoms when consuming formalin and borax foods.

As for the logic of the certainty factor in the system consultation session, consulting users were given a choice of answers, each of which had the following weights:

Table 2: Confidence Weight

No	Description	Weight
1	Not sure	0
2	Do not know	0.1
3	A little sure	0.2
4	Sure enough	0.6
5	Sure	0.8
6	Very sure	1
7	Not sure	0

RESULTS AND DISCUSSION

Weighting process on each premise to obtain a percentage of confidence to identify foods containing formalin and borax.

Table 3: Percentage of Conclusions

Percentage	Belief Value
0% -50%	Little possibility
51% -79%	Possibility
80% -99%	Most likely
100%	Very sure

In expressing the degree of certainty, certainty factor is to assume the degree of certainty of an expert on a data. This concept is then formulated in the basic formula as follows:

$CF[H,E]=MB[H,E]-MD[H,E]$
$CF[H,E]1=CF[H]*CF[E]$
CFcombineCF[H,E] 1,2 + CF[H,E] 2* [1-CF[H,E] 1]
Cfcombine CF[H,E] old,3 = CF[H,E] old + CF[H,E] 3 * [1-CF[H,E] old]
The production rules or rule rules relating to foods containing formalin and borax are as follows:
The first step, experts determine the CF for each of the following characteristics:
Expert CF (Very springy)   = 0.2
Expert CF (Stay intact for 3 days) = 0.2
Expert CF (Color tends to mix)   = 0.4
CF expert (stinging aroma)   = 0.8
Expert CF (Tend hard)   = 0.5
Expert CF (Balances like a ball)   = 0.4
CF expert (Not stale 5 days)   = 0.6
Suppose the user chooses the answer as follows:
Very thick   = A little sure   = 0.2
Stay intact for 3 days   = Sure enough   = 0.6
Color tends to bersi   = a little sure   = 0.2
Stinging aroma   = Sure   = 0.8
Tends to be hard   = Sure   = 0.8
Balancing like a ball   = Sure   = 0.8
Not stale 5 days   = Very sure   = 1
The rule is then calculated by the value of Cf by multiplying Cf the confidence weight with CF to be:

CF[H,E] 1 = CF[H] 1 * CF[E] 1
$\qquad$ =0.2 * 0.2
$\qquad$ =0.04
CF[H,E] 2 = CF[H] 2 * CF[E] 2
$\qquad$ =0.2 * 0.6
$\qquad$ =0.12
CF[H,E]3 = CF[H] 3 * CF[E] 3
$\qquad$ = 0.4 * 0.2
$\qquad$ = 0.8
CF[H,E] 4 = CF[H] 4 * CF[E] 4
$\qquad$ = 0.8 * 0.8
$\qquad$ = 0.64
CF[H,E] 5 = CF[H] 5 * CF[E] 5
$\qquad$ = 0.5 * 0.8
$\qquad$ = 0.40
CF[H,E] 6 = CF[H] 6 * CF[E] 6
$\qquad$ = 0.4 * 0.8
$\qquad$ = 0.32
CF[H,E] 7 = CF[H] 7 * CF[E] 7
$\qquad$ = 0.4 * 0.8
$\qquad$ = 0.32
CF[H,E] 8 = CF[H] 8 * CF[E] 8
$\qquad$ = 0.6 * 1
$\qquad$ = 0.6

The final step is to combine CF values from rules. Next is to combine CF [E] with CF [H, E]:
CFcombineCF[H,E] 1,2 = CF[H,E] 1 + CF[H,E] 2 * (1- CF[H,E] 1)
$\qquad$ = 0.04 + 0.12 * (1-0.04)
$\qquad$ = 0.1536 old
CFcombine CF[H,E] old,3 = CF[H,E] old + CF[H,E] 3 * (1- CF[H,E] old)
$\qquad$ =0.1536+ 0.8 * (1 – 0.1536)
$\qquad$ = 0.807127 old 2
CFcombine CF[H,E] old2,4 = CF[H,E] old + CF[H,E] 4 * (1- CF[H,E] old2)
$\qquad$ = 0.807127+ 0.64 * (1 – 0.807127)
$\qquad$ = 0.2791117 old 3
CFcombine CF[H,E] old3,5 = CF[H,E] old + CF[H,E] 5 * (1- CF[H,E] old3)
$\qquad$ = 0,2791117 + 0.40 * (1 – 0.2791117)
$\qquad$ = 0.2313246 old 4
CFcombine CF[H,E] old4,6 = CF[H,E] old + CF[H,E] 6 * (1- CF[H,E] old4)
$\qquad$ = 0.2313246 + 0.32 * (1 – 0.2313246)
$\qquad$ = 0.4237897 old 5
CFcombine CF[H,E] old5,7 = CF[H,E] old + CF[H,E] 7 * (1- CF[H,E] old5)
$\qquad$ = 0.4237897 + 0.6 * (1 – 0.4237897)
$\qquad$ = 0.5899182 old 6
CF[H,E] old8 * 100 = 0.5899182 * 100 = 58.99182%

Thus it can be said that the calculation of certainty factor formalin and borax in food has a percentage of confidence level of 58.99182%.

CONCLUSION

Certainty Factor is one algorithm that is quite good in carrying out the inspection process based on existing conditions, based on tests conducted to check formalin and borax on food obtained quite accurate results with a high percentage. The method of certainty factor can be combined with other expert system methods or with decision support system methods so that if the results obtained are good then the results of the decision can be executed and provide recommendations to users.

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