

Dayak Onion (*Eleutherine palmifolia* (L) Merr) as An Alternative Treatment in Early Detection of Dental Caries using Certainty Factor

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Abstract—Dayak onion plants are traditionally used by the Dayak tribe as a medicinal plant to treat dental caries. This plant contains compounds that can inhibit the growth of bacteria that cause dental caries. The public has not yet known about alternative dental caries treatment derived from Dayak onions. This is due to the lack of public knowledge about how to early diagnose dental caries and how to treat using Dayak onions. Expert systems with the Certainty Factor method can be used as a solution in diagnosing early dental caries. The data used in this study consisted of 20 symptoms of dental caries and 6 types of dental caries. This study shows the percentage level of confidence in the results of the initial diagnosis of the type of dental caries suffered by using the certainty factor method and the handling of the diagnosis using the Dayak plant as an initial treatment solution. The results of the accuracy-test showed that the early dental caries diagnosis system was working well.

Keywords—Dayak onion, dental caries, certainty factor,

I. INTRODUCTION

Biodiversity on the island of Kalimantan has various potentials, including the potential for medicinal plants. The potential of these medicinal plants is scattered in various forest areas in Kalimantan. In terms of utilization, various types of medicinal plants in Kalimantan forests have their properties and have great potential to be developed as traditional or herbal medicines [1], [2]. The use of herbs as traditional medicine has become one of the alternative treatments that are in demand by the community. Medicinal plants that are useful for herbal medicine and are often found in everyday life are onions. Onions are a general term for a group of important plants for humans belonging to the Genus *Allium*. Tubers, leaves, or flowers are used as vegetables or as spices, depending on how they are used [3].

Dayak onions (*Eleutherine palmifolia* (L.) Merr.) Contain several compounds that act as antimicrobials to inhibit the growth of bacteria that cause dental caries such as alkaloids, glycosides, flavonoids, phenolics, steroids, tannins, and saponins [4]. Compounds that can inhibit the growth of bacteria that cause dental caries in Dayak onions are phenols with a high concentration of 34.32%. Phenolic compounds also function as disinfectants to inhibit gram-positive and negative bacteria. Gram-positive "cocci" and gram-negative "coccobacilli" bacteria can be found in root canals that

colonize necrotic teeth and work together to cause infection [5]–[7].

Dental caries is an infectious disease caused by the demineralization of enamel and dentin which is closely related to the consumption of cariogenic foods [8]. Dental caries or cavities are characterized by damaged enamel and dentin caused by bacterial metabolic activity in plaque which causes demineralization due to interactions between microorganism products, saliva, and parts derived from food and enamel [9]. Dental caries can cause further damage to the dental pulp in the form of reduced blood flow to the death of the nerves in the affected tooth [6]. Initial treatment for caries-affected teeth must be done quickly so that the pain experienced by people with dental caries can be minimized. However, this is constrained by the lack of knowledge about the type of dental caries suffered. Therefore, an initial diagnosis is needed to determine the type of dental caries suffered and an initial treatment solution using the medicinal plant Dayak onion which has been proven as an alternative treatment for dental caries.

The expert system can be used as a solution to diagnose the early types of dental caries. Expert systems are computer programs derived from the branch of computer science research called artificial intelligence [10] and have been widely used for the diagnosis of various diseases such as dermatitis disease [11], fever disease [12], meningitis disease [13], rickets disease [14] and others [15]–[19]. The part of the expert system contains two main components, namely the knowledge base which contains the knowledge to act as a consultant, and the inference engine that presents the results. The result is an expert system response to user requests [18]. The Certainty Factor states belief in an event (fact or hypothesis) based on expert evidence or judgment. Certainty Factor has a higher level of accuracy than other methods because the calculation method only compares each of the two values [20].

This study built an expert system to identify the results of early diagnosis of the type of dental caries using the Certainty Factor method as a calculation method to obtain the level of accuracy of the diagnosis of the type of dental caries suffered. This expert system is expected to be able to assist the public in knowing the type of dental caries suffered by and provide information about how to treat it using Dayak onions.

II. RESEARCH METHODOLOGY

A. Dayak Onion

Dayak onions or ghost onions which have the scientific name *Eleutherine palmifolia* (L.) Merr is typical plant in the Kalimantan region. This plant is traditionally used by the Dayak tribe as a medicinal plant. It has a red tuber color with green leaves in the form of ribbons and white flowers. Dayak onions can be used as an alternative medicine to treat dental caries. This is because Dayak onions contain phytochemical compounds, namely alkaloids, glycosides, flavonoids, phenolics, steroids, and tannins [3], [21]. The content of these chemical compounds can inhibit and kill bacterial activity. Dayak bulb extract which can inhibit bacterial growth has the advantage of natural properties of herbal plants which are relatively safe for the body. "Fig. 1" shows the shape of the Dayak onion plant.



Fig. 1. Dayak Onion

From "Fig. 1" it can be seen that the shape of the Dayak onions resembles tubers. Dayak onions are known to have inhibitory power to treat dental caries which consists of

1. Inhibition of Dayak Onions against *Streptococcus mutans*

Dental caries is a disease of the hard tissues of the teeth, one of which is caused by *Streptococcus mutans* (*S. mutans*) bacteria. Bacteria that have accumulated on the tooth surface will continue to ferment carbohydrates which produce lactic acid so that it can lower the pH of the oral cavity. *S. mutans* growth can be prevented by giving mouthwash containing antibacterial compounds. The extract of Dayak onions is anti-bacterial because it contains active phenolic compounds and flavonoids. Phenolic compounds and their derivatives have anti-glycosyltransferase substances so that they can suppress the glycosyltransferase enzyme excreted by *S. mutans* and can prevent the growth of the *S. mutans* matrix so that these bacteria cannot adhere to the surface of tooth enamel [22].

2. Inhibition of Dayak Onions against *Lactobacillus Acidophilus*

Lactobacillus Acidophilus bacteria are believed to be pioneering bacteria in advanced caries because these bacteria are more isolated in deep caries than before caries development and early tooth damage [23]. Dayak bulb extract can inhibit the growth of *Lactobacillus Acidophilus* bacteria due to the presence of flavonoid compounds. The mechanism of flavonoids as an antibacterial is to denature the cell membrane so that intracellular compounds come out which can cause cell damage or cell death [24].

B. Dental Caries

Based on data from The Global Burden of Disease Study 2016, dental and oral health problems, especially dental caries, are a disease that affects nearly half of the world's population (3.58 billion people). In Indonesia, the prevalence of caries according to data from the Ministry of Health of the Republic of Indonesia in 2018 was 88.8% with a prevalence of root caries of 56.6%. Dental caries generally attacks adolescents and adults due to the high consumption of foods and drinks containing sugar [25]. The word caries itself comes from the Latin which means rot or rotten. Dental caries is a chronic contagious disease caused by the perfect interaction between oral microorganisms in dental plaque, diet, and various host factors (living organisms) such as social and environmental [26]. The bacteria that cause dental caries are *Streptococcus mutans* (*S. mutans*) and *Lactobacillus acidophilus* (*L. acidophilus*) bacteria. These bacteria in the mouth convert sugar into acids which can erode tooth enamel [24].

C. Expert System

The development of technology makes it easier for experienced doctors to document their knowledge and experience. This documentation can be expressed in a system that uses artificial intelligence and a knowledge base to act as a consultant in helping doctors to diagnose various kinds of diseases called expert systems. An expert system is a computer-based system that uses knowledge, facts, and reasoning techniques to solve problems that usually only an expert in the field can solve [27]. The expert system consists of two main components, namely the knowledge base which contains the knowledge, and the inference engine that presents the results.

The concept of an expert system consists of users to convey facts or information to experts which will then be stored in a knowledge-base and processed by an inference engine so that the system can provide feedback to users in the form of expertise or answers based on previously conveyed knowledge [28]. Expert systems are built with two environments, namely the consultation environment and development environment. In a development environment, an expert system is used to enter expert knowledge into an expert system environment. Furthermore, the consulting environment is used by non-expert users to obtain expert knowledge and advice.

D. Certainty Factor

The certainty factor (CF) is a way of combining trust and unbelief in a single number. In certainty theory, qualitative data is presented as a degree of belief. There are two steps in representing qualitative data. The first step is the ability to express the degree of belief according to the method. The second step is to be able to locate data combining these degrees of confidence in an expert system [29], [30]. This concept is then formulated in (1).

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

Explanation:

CF: Certainty Factor from hypothesis H which is affected by evidence E. Biggest CF revolve between -1 until 1. Value 1 show belief unconditional, while value -1 show disbelief unconditional.

MB : Measure of Belief (confidence level), is a measure of the increase of trust hypothesis H is affected by the fact E.

MD : Measure of Disbelief (not confidence level), is the belief of mistrust hypothesis influenced the fact E

E : Evidence (events or facts)

H : Hypothesis (Alleged).

The calculation of certainty factor can be combined with two or more rules that have different evidence but in the same hypothesis as follows:

$$\text{Rule 1 } CF(H, E1) = CF1 = C(E1) \times CF(\text{Rule1}) \quad (2)$$

$$\text{Rule 2 } CF(H, E2) = CF1 = C(E2) \times CF(\text{Rule2}) \quad (3)$$

$$CF_{\text{combine}} [CF1, CF2] = CF1 + CF2 * (1 - CF1) \quad (4)$$

The certainty factor value states the level of expert confidence in an event (facts or hypotheses). The value of CF (Rule) is obtained from the interpretation of "terms" from experts which are converted into certain CF values. The value of certainty factor has the value ranges between -1 to 1. The value of -1 shows the evidence of absolute untrusted value whilst value 1 refers to absolute trustworthiness. In calculating the certainty factor only users two data so that the accuracy of the data can be maintained and in an expert system the certainty factor can measure how much confidence the expert system has in diagnosing disease.

E. Analysis and Design of Expert System

This section will explain the stages in building an expert system as follows:

1) Knowledge Base

The knowledge base gives description from rules used in system to diagnose in. The knowledge base in this study was obtained from interviews with experts who produced six types of dental caries. Types of dental caries can be seen in TABLE I.

TABLE I. DENTAL CARIES DISEASE

Code	Name of Disease
K001	Reversible pulpitis
K002	Irreversible pulpitis
K003	Hyperplastic pulpitis
K004	Pulp Necrosis
K005	Pulp Gangrene
K006	Gangrene Radix

After getting the types of dental caries disease, the results of the interview then obtained a list of twenty symptoms in the six types of dental caries.

TABLE II. DENTAL CARIES SYMPTOMS

Symptom Code	Symptom Name
G001	Bad breath
G002	There are holes in the teeth
G003	Sometimes a sharp pain when eating acidic food
G004	Sometimes a sharp pain if you eat sweet food
G005	Sometimes a sharp pain when eating salty food

Symptom Code	Symptom Name
G006	Sometimes a sharp pain when eating spicy food
G007	Sometimes a sharp pain when eating hot food
G008	Sometimes a sharp pain when eating cold food
G009	Pain suddenly (spontaneously)
G010	Pain that lasts longer than 30 seconds
G011	Sometimes the pain is mild to severe and fever occurs
G012	Sometimes a throbbing pain
G013	Sometimes the pain gets worse at night
G014	The teeth that were eroded were even wider until they sprouted small flesh
G015	Meat that grows when exposed to rough food or drink aches
G016	The teeth have started to feel numb
G017	The teeth have started to rot
G018	Teeth turn brown, gray
G019	Teeth are only roots
G020	The crown of the tooth is no longer visible

2) Rule of Certainty Factor

At this stage, the weight value for each symptom present in each type of dental caries disease is determined by an expert on a scale of values between 0,2 – 1,0

TABLE III. THE WEIGHT OF SYMPTOMS

Symptom Code	Symptom Name	Weight
G001	Bad breath	0,3
G002	There are holes in the teeth	0,3
G003	Sometimes a sharp pain when eating acidic food	0,4
G004	Sometimes a sharp pain if you eat sweet food	0,4
G005	Sometimes a sharp pain when eating salty food	0,4
G006	Sometimes a sharp pain when eating spicy food	0,4
G007	Sometimes a sharp pain when eating hot food	0,4
G008	Sometimes a sharp pain when eating cold food	0,4
G009	Pain suddenly (spontaneously)	0,8
G010	Pain that lasts longer than 30 seconds	0,8
G011	Sometimes the pain is mild to severe and fever occurs	0,6
G012	Sometimes a throbbing pain	0,6
G013	Sometimes the pain gets worse at night	0,6
G014	The teeth that were eroded were even wider until they sprouted small flesh	0,6
G015	Meat that grows when exposed to rough food or drink aches	0,6
G016	The teeth have started to feel numb	0,7
G017	The teeth have started to rot	0,7
G018	Teeth turn brown, gray	0,8
G019	Teeth are only roots	0,8
G020	The crown of the tooth is no longer visible	0,8

In applying the CF method to an expert system requires several rules in the form of symptoms and weight values that have been given by the expert. The rules formed from the symptoms and weight values from the experts for each disease are shown in TABLE IV.

TABLE IV. RULES

No	Rule
1	IF G001 (0,3) AND G002 (0,3) AND G003 (0,4) AND G004 (0,4) AND G005 (0,4) AND G006 (0,4) AND G007 (0,4) AND G008 (0,4) THEN K001
2	IF G001 (0,3) AND G002 (0,3) AND G009 (0,8) AND G010 (0,8) AND G011 (0,6) AND G012 (0,6) AND G013 (0,6) THEN K002
3	IF G001 (0,3) AND G002 (0,3) AND G014 (0,6) AND G015 (0,6) THEN K003
4	IF G001 (0,3) AND G002 (0,3) AND G016 (0,7) AND G017 (0,7) THEN K004
5	IF G001 (0,3) AND G002 (0,3) AND G016 (0,7) AND G017 (0,7) AND G018 (0,8) THEN K005
6	IF G001 (0,3) AND G019 (0,8) AND G020 (0,8) THEN K006

3) Dental Caries Treatment

The method of treating dental caries using Dayak onions as an alternative treatment and prevention of dental caries is further determined based on the type of dental caries selected. Each type of dental caries has different treatment methods, especially in the use of the amount of Dayak onions used.

TABLE V. TREATMENT USING DAYAK ONION

Code of Disease	Treatment
K001	<p>Treatments using Dayak onions are as follows:</p> <ul style="list-style-type: none"> Take 1-3 cloves of Dayak onion then peeled. Wash the Dayak onions with clean water. Grate or grind the Dayak bulbs and put the grated results in a glass. Then pour warm water and stir until well. Then use it to gargle. Do it 2-3 times a day for 7 days.
K002	<p>Treatments using Dayak onions are as follows:</p> <ul style="list-style-type: none"> Take 3-4 cloves of Dayak onion then peeled. Wash the Dayak onions with clean water. Grate or grind the Dayak bulbs and put the grated results in a glass. Then pour warm water and stir until well. Then use it to gargle. Do it 2-3 times a day for 7 days.
K003	<p>Treatments using Dayak onions are as follows:</p> <ul style="list-style-type: none"> Take 2-3 cloves of Dayak onion bulbs and then peeled. Wash the Dayak onions with clean water. Puree the Dayak onions by pounding them until smooth. The results of the collision of Dayak onions are inserted into the cavities and rubbed around the cavities. Let for about 30 minutes then rinse with clean water. Do it 2-3 times a day for 7 days, the longer the duration of use will further reduce pain in cavities.
K004	<p>Treatments using Dayak onions are as follows:</p> <ul style="list-style-type: none"> Take 2-4 cloves of Dayak onion bulbs and then peeled. Wash the Dayak onions with clean water. Puree the Dayak onions by pounding them until smooth. The results of the collision of Dayak onions are inserted into the cavities and rubbed around the cavities. Let for about 30 minutes then rinse with clean water. Do it 1-3 times a day for 7 days, the longer the duration of use will further reduce pain in cavities.
K005	<p>Treatments using Dayak onions are as follows:</p> <ul style="list-style-type: none"> Take 3-4 cloves of Dayak onion bulbs and then peeled. Wash the Dayak onions with clean water. Puree the Dayak onions by pounding them until smooth. The results of the collision of Dayak onions are inserted into the cavities and rubbed around the cavities. Let for about 30 minutes then rinse with clean water.

Code of Disease	Treatment
	<ul style="list-style-type: none"> Do it 2-3 times a day for 7 days, the longer the duration of use will further reduce pain in cavities.
K006	<p>Treatments using Dayak onions are as follows:</p> <ul style="list-style-type: none"> Take 3-4 cloves of Dayak onion bulbs and then peeled. Wash the Dayak onions with clean water. Puree the Dayak onions by pounding them until smooth. The results of the collision of Dayak onions are inserted into the cavities and rubbed around the cavities. Let for about 30 minutes then rinse with clean water. Do it 1-3 times a day for 7 days, the longer the duration of use will further reduce pain in cavities. Patients are advised to go to a dental specialist to remove remaining teeth or roots that are left and no longer useful.

III. RESULT AND DISCUSSION

This section describes the implementation of an expert system that has been built to diagnose the beginning of dental caries and explains the calculation of certainty factors produced by the system.

A. Implementation System

The consultation page displays a list of symptoms entered by user. The symptom input display selected by user is shown in "Fig. 2". The user selects each symptom they feel based on their level of confidence. User can select the confidence levels are A little Sure (0,2), Quite Sure (0,5), Sure (0,7) and Very Sure (0,9).

Code	Symptom Name	a little sure	quite sure	Sure	Very Sure
G001	Bad breath	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
G002	There are holes in the teeth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G003	Sometimes a sharp pain when eating acidic food	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G004	Sometimes a sharp pain if you eat sweet food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G005	Sometimes a sharp pain when eating salty food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G006	Sometimes a sharp pain when eating spicy food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G007	Sometimes a sharp pain when eating hot food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G008	Sometimes a sharp pain when eating cold food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G009	Pain suddenly (spontaneously)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
G010	Pain that lasts longer than 30 seconds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G011	Sometimes the pain is mild to severe and fever occurs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G012	Sometimes a throbbing pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G013	Sometimes the pain gets worse at night	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G014	The teeth that were eroded were even wider until they sprou...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G015	Meat that grows when exposed to rough food or drink aches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G016	The teeth have started to feel numb	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G017	The teeth have started to rot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G018	Teeth turn brown, grey	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G019	Teeth are only roots	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Fig. 2. Consultation Page View

After selecting the symptom, the system will display the diagnostic results as shown in "Fig. 3". The diagnostic results show the early diagnosis of the type of dental caries based on the symptoms that have been previously selected, namely Irreversible Pulpitis with a confidence level of 84.516%.

Name	Diagnosis Result	Confidence
Budi	Irreversible pulpitis	84.516%

Fig. 3. Results Diagnostic

The next display is treatment using Dayak Onions in accordance with the results of the diagnosis given by the system as in "Fig. 4". Treatment of dental caries Irreversible Pulpitis using Dayak Onions refers to TABLE V.

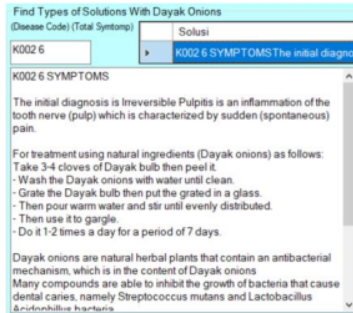


Fig. 4. Treatment using Dayak Onion Page

B. Calculation of Certainty Factor

Calculations to get an early diagnosis of dental caries using the CF method were carried out in several stages. The first stage of using the CF method in the calculation process is to determine the confidence value of the symptoms that have been selected by user (CF user) and the weight value of the rules given by the expert (CF expert) as in TABLE VI.

TABLE VI. THE VALUE OF CF EXPERT AND CF USER OF SELECTED SYMPTOMS

Symptom Code	Symptom Name	CF Expert	CF User
G001	Bad breath	0,3	0,7
G003	Sometimes a sharp pain when eating acidic food	0,4	0,5
G009	Pain suddenly (spontaneously)	0,8	0,9
G013	Sometimes the pain gets worse at night	0,6	0,5
G016	The teeth have started to feel numb	0,7	0,2
G019	Teeth are only roots	0,8	0,2

The next stage is to calculate the CF value of each rule by multiplying the value of CF expert with CF user as follows

Rule 1 : Reversible pulpitis

$$CF1 = CF_{pakar} \times CF_{user} = 0,3 \times 0,7 = 0,21$$

$$CF2 = CF_{pakar} \times CF_{user} = 0,3 \times 0 = 0$$

$$CF3 = CF_{pakar} \times CF_{user} = 0,4 \times 0,5 = 0,2$$

$$CF4 = CF_{pakar} \times CF_{user} = 0,4 \times 0 = 0$$

$$CF5 = CF_{pakar} \times CF_{user} = 0,4 \times 0 = 0$$

$$CF6 = CF_{pakar} \times CF_{user} = 0,4 \times 0 = 0$$

$$CF7 = CF_{pakar} \times CF_{user} = 0,4 \times 0 = 0$$

$$CF8 = CF_{pakar} \times CF_{user} = 0,4 \times 0,25 = 0,1$$

The results of calculating the CF value of each rule can be seen in the TABLE VII.

TABLE VII. THE CF VALUES OF EACH RULE

CF	Code of Rule					
	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
CF1	0,21	0,21	0,21	0,21	0,21	0,21
CF2	0	0	0	0	0	0,16
CF3	0,2	0,72	0	0,14	0,14	0

CF	Code of Rule					
	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
CF4	0	0	0	0	0	0
CF5	0	0			0	
CF6	0	0				
CF7		0,3				
CF8	0					

The next step is to combine the CF values of each rule using (4) to determine the type of dental caries, as follows:

Rule 2: Irreversible pulpitis

$$CF_{combine} (CF1, CF2) = 0,21 + 0 * (1 - 0,21) = 0,21 \rightarrow CF_{new1}$$

$$CF_{combine} (CF_{new1}, CF3) = 0,21 + 0,72 * (1 - 0,21) = 0,7788 \rightarrow CF_{new2}$$

$$CF_{combine} (CF_{new2}, CF4) = 0,7788 + 0 * (1 - 0,7788) = 0,7788 \rightarrow CF_{new3}$$

$$CF_{combine} (CF_{new3}, CF5) = 0,7788 + 0 * (1 - 0,7788) = 0,7788 \rightarrow CF_{new4}$$

$$CF_{combine} (CF_{new4}, CF6) = 0,7788 + 0 * (1 - 0,7788) = 0,7788 \rightarrow CF_{new5}$$

$$CF_{combine} (CF_{new5}, CF7) = 0,7788 + 0,3 * (1 - 0,7788) = 0,84516$$

$$\begin{aligned} \text{Percentage of Confidence} &= CF_{combine} * 100\% \\ &= 0,84516 * 100\% \\ &= 84,516\% \text{ Irreversible pulpitis} \end{aligned}$$

The results of calculating the combined CF values of each rule can be seen in the table.

TABLE VIII. THE COMBINED CF VALUES OF EACH RULE

No	Name of Disease	CF	CF (%)
1	Reversible pulpitis	0,368	36,8
2	Irreversible pulpitis	0,84516	84,516
3	Hyperplastic pulpitis	0,21	21
4	Pulp Necrosis	0,3206	32,06
5	Pulp Gangrene	0,3206	32,06
6	Gangrene Radix	0,3364	33,64

From the calculation of the CF value of each rule, the highest CF value with a percentage of 84.516% is Irreversible Pulpitis. Furthermore, the treatment method for the results of the initial diagnosis of types of dental caries Irreversible Pulpitis using Dayak onions which refers to TABLE V.

C. Testing Result

Testing is done by comparing the results of the diagnosis provided by an expert system with an expert so that the accuracy of the expert system being built can be found. TABLE IX shows the test results of cases of early diagnosis of dental caries.

TABLE IX. THE COMBINED CF VALUES OF EACH RULE

No	Symptoms	System Results	Diagnostic Expert	True/False
1	G002, G004, G017, G020	Gangrene Radix CF = 62,6%	Gangrene Radix	True
2	G002, G003, G015, G018, G020	Reversible Pulpitis CF = 36,8%	Reversible Pulpitis	True
3	G003, G009, G011, G016	Irreversible Pulpitis CF = 65,2%	Irreversible Pulpitis	True
4	G005, G008, G012, G013, G014	Hyperplastic pulpitis CF = 45,48%	Hyperplastic Pulpitis	True
5	G001, G002, G017, G018	Pulp Gangrene CF = 55,17%	Pulp Gangrene	True
6	G006, G009, G010, G013, G016	Pulp Necrosis CF = 49%	Pulp Necrosis	True

The results of case testing consisting of six test case studies in TABLE IX show that six data are in accordance with the expert's data. This shows that the expert system has an accuracy of 100%.

IV. CONCLUSION

This study has succeeded in building an expert system that can early diagnose types of dental caries and provide recommendations for treating dental caries using traditional Dayak herbs. Based on the results of the initial diagnosis of dental caries on the symptoms given by the user, the appropriate treatment using Dayak onions is gargling according to advice to inhibit the growth of bacteria that cause dental caries so that it does not get worse. The result of testing the accuracy level of the expert system for early diagnosis of dental caries by 100% proves that this expert system is able to work well to diagnose the type of dental caries accompanied by proper treatment using Dayak onions.

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