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Chemical Component of Sengon Tree Digested *Xystrocera festiva* (Coleoptera: Cerambycidae) Larvae

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ABSTRACT

Xystrocera festiva Thoms. (famili Cerambycidae, ordo Coleoptera) classified as the most harmful pest in Sengon (*Falcataria moluccana*) plantations in Indonesia. The larvae of the pest eat the inner bark and sapwood of the sengon tree since the tree are 3 years old. However, the chemical component(s) of the inner bark and sapwood digested were still unknown. Therefore, the aim of this study was to identify chemical components of the tree eaten by the larvae of sengon *X. festiva*. The materials used for the analysis were the excrement on the bark surface and inside the bark, uneaten sapwood (outher bark), uneaten bark and healthy bark. The result saw that the larvae eat cellulose, hemicellulose, protein and starch contained in the inner bark and sapwood. However in the feces from larval still found hemicellulose, cellulose and protein. This means that all materials could not be digested by the larvae of *X. festiva*. From the chemical analysis of wood indicated that important larval food of *X. festiva* was hemicellulose and cellulose.

Keywords: *cellulose, Sengon, Xystrocera festiva*

1. INTRODUCTION

Xystrocera festiva Pascoe (Famili Cerambycidae, Ordo Coleoptera) classified as the most harmful pest in sengon (*Paraserianthes falcataria* (L.) Nielsen) plantations in Indonesia. This pest known as Boktor eat the inner bark and sapwood of sengon trees since the trees are 3 years of age. Boktor pest attack can causing trees death, breaking of tree stem, and reducing the number and quality of sengon wood produced.

Boktor lays the eggs in a group under the bark gap or in the section wound on sengon stem [1]. After the eggs hatch, young larvae immediately damage inside of the bark and outside of the sapwood. At time spoiling the stem, larvae make small holes in the surface of the bark and secrete a white excrement. The presence of excrement coming out of the bark raises the question of what boktor larvae actually eat? Starch, proteins, cellulose or other chemical components. Aim of this study was to identify the chemical components in parts of sengon tree eaten by the *Xystrocera festiva* larvae.

2. MATERIALS AND METHODS

2.1. Preparation of raw materials

Material for identification were collected from the private sengon plantation at Jasinga, Bogor, Jawa Barat. The material used for analysis part of sengon tree eaten by *X. festiva* were excrement on the bark surface and inside the bark, uneaten sapwood (outher bark), uneaten bark and healthy bark. Chemical material for analysis the content of cellulose, hemicellulose, holocellulose, starch, and proteins on the part of sengon tree were sodium chlorite ($NaClO_2$) crystal, acetic acid (CH_3COOH) glacial, acetic acid 10%, NaOH solution 17.5%, NaOH solution 8%, dan destilled water.

2.2. Analysis wood chemical components

Analysis wood chemical components includes determination of holocellulose levels, α- cellulose levels, cellulose and hemicellulose levels obtained from the calculation of holocellulose and α-cellulose levels followed by determination of starch and proteins content.

2.3. Analysis of holocellulose levels

The extractive-free wood sample equivalent 2 g was place in a 250 ml erlenmeyer. A total of 100 ml destilled water, 1 g sodium chlorite ($NaClO_2$), and 1 ml glacial acetic acid (CH_3COOH are added. The mixture was heated in a water bath at 80 ºC. as much as 1 g sodium chlorite and 0.2 ml acetic acid are added at each heating interval for 1 hour, the addition was made 4 time. The samples were filtered and washed using hot water. As much as 25 ml acetic acid 10% is added and then washed with hot water until free acid.

Samples were oven at 105 ± 3 ºC until their weight was constant, then cooled and weighed. Calculation of % holocellulose levels using the following formula:

$$\text{Holocellulose (\%)} = \frac{A}{B} \times 100$$

A: Holocellulose weight (g);
B: Dry weight of wood (g)

2.4. Analysis of α-cellulose levels

A total of 1.5 g holocellulose was weighed and placed in a 200 ml beaker. As much as 75 ml NaOH 17.5% was added and stirred. Leave it at 25 ± 0.2 ºC for 30 minutes. 100 ml water destilled was added and left for 30 minutes next. The sample was filtered and rinsed until free acid and then oven at 105 ± 3 ºC until constant weight, then cooled and weighed.

Calculation of α-cellulose levels using the following formula:

$$\alpha\text{-cellulose (\%)} = \frac{A}{B} \times 100$$

A: α-cellulose weight (g);
B: Dry weight of wood (g)

Cellulose levels (%) = % Holocellulose x % α-cellulose

2.5. Analysis of starch content

Calculation of hemicellulose levels using the following formula:

Hemicellulose levels (%) = % Holocellulose - % cellulose

Sample of ± 5 g were weighed and put into a 500 ml erlenmeyer, dampened with alcohol 96% as much as 10 ml and added as much as 200 ml HCl (1:11). After 1 hour, the extract is filtered and mixed with cold distilled water. Then added the Phenol Phtalein indicator and neutralized with 4 N NaOH. A total of 10 ml of sample solution was boiled for 10 minutes then cooled. After chilling, added 15 ml of 20% KI, 25 ml H_2SO_4 4 N, then titrated with 0.1 N solution of $Na_2S_2O_3.5H_2O$ (tio 0.1 N) with 2% amylum indicator (for blank determination).

2.6. Analysis of proteins content

Sample of ± 0.3 g were weighed and ± 1.5 g of *Selenium Mixture* catalyst were added. The solution was put into a Kjeldahl flask and 20 ml of concentrated H_2SO_4 was added. Digested until the color of solution became green-yellowish-clear and cooled for ± 15 minutes. As much as 300 ml of distilled water was added and then cooled again. As much as 100 ml NaOH 40% was added and then cooled again. The result of distillation was collected with 10 ml H_2SO_4 0.1 N which 3 drops mixture indicator of Methylen Blue and Methylen Red. The solution was titrated with NaOH 0.1 N until the color changed from purple to blue-green. Determination of blank: pipette 10 ml H_2SO_4 0.1 N and added 2 drops of PP indicator titrated with NaOH 0.1 N.

3. RESULT AND DISCUSSION

Carbohydrates are a source of energy needed by the *X. festiva* which is fulfilled through its food. Carbohydrates needed by insects derived from cellulose, hemicellulose, and starch which are components structural wood. Cellulose is a source of carbohydrates which becomes a source energy for insects.

Table 1 showed that the highest content of wood was holocellulose, apart from protein and starch. The result of analysis chemical components of sengon tree eaten by the X. festiva larvae can be seen in Table 1.

Based on Tabel 1, the result of wood chemical analysis showed that all wood chemical components and inner bark (holocellulose, cellulose, hemicellulose, strach, and proteins) were eaten by *X. festiva* larvae. Excrement on the bark surface (holocellulose levels 76.45%) didnot appear to be eaten when compared to holocellulose on uneaten sapwood (77.06%). This research showed that the excrement on the bark surface all comes from sapwood. The healthy bark was eaten appeared to be less from holocellulose on uneaten bark (63.19%) when compared to holocellulose on uneaten outher bark (54.41%). However, starch and proteins on all the part of trees analyzed didnot appear to be eaten, judging from the wood chemical content which was almost same as uneaten sapwood.

Hemicellulose was the most digested material compared to cellulose (Table 2) because hemicellulose has short chain, making it easier to digest. Lignin was the tree chemical content that may not be digested by X. festiva larvae, this was because the building blocks of lignin were not aren't glucose like other wood components, the lignin did have nutrional content for X. festiva larvae.

The chemical components of wood are needed to be studied for developing artificial diet for insects, particularly for stem borer insect. Insect rearing was mostly done in the laboratory using artificial diet in order to study insect morphology, behavior, life cycle, and development of insect population. According to [2] artificial diet is unnatural food for insects which is made by certain process. Rearing of X. festiva using artifial diet was done by [3] and [4] with the aim to studying the life cycle of these insects. [5], [6], and [7] have also carried out the rearing of X. festiva by using artificial diet with ingredients composition as shown in Table 3.

Which food composition is best for larvae to maturity has yet to be concluded. This is because the studies were not carried out until the larvae became adult (beetles). In contrast to research of [3] and [4], using larvae that are hatched from eggs and their maintenance continues until the larva became beetles.

[8] rearing *Aeolesthes sarta* Solsky which is the same famili with *X. festiva* (Cerambycidae) using artificial diet consisting of 16 g of flour from stem elm tree (*Ulmus* sp.); 70 cc destilled water; 0.3 g *benzoid acid*; 0.4 g *hydroxy benzoate*; 0.3 g nipagin; 5 g agar; and 4 g yeast extract. These materials are made into a paste, it turns out that *A. sarta*'s first instar larvae can develop well adult insects. It seems that the composition of artificial diet by Farashiani *et al.* can try this for maintenance *X. festiva* by substituting flour from stem elm tree (*Ulmus* sp.) with flour from stem sengon tree (*Paraserianthes falcataria*).

Table 1. Chemical components of sengon tree eaten by the *Xystrocera festiva* larvae

No	Part of tree	Chemical content of trees in percent dry weight (%)				
		Holocellulose	Cellulose	Hemicellulose	Starch	Proteins
1	Uneaten sapwood (outher bark)	77.06	38.47	38.59	2.67	5.28
2	Excrement on the bark surface	76.45	36.15	40.30	3.00	5.57
3	Healthy bark (outside and inside)	63.19	27.45	35.74	3.53	8.77
4	Uneaten bark (outher bark)	54.41	19.35	35.06	2.88	6.59
5	Average of wood and bark chemical content: (1 + 3): 2	70.12	32.96	37.16	3.10	7.02
6	Excrement inside the bark	32.07	9.07	23.00	2.27	2.35
7	Average of wood and bark chemical content uneaten: (4 + 6) : 2	43.24	14.21	29.03	2.57	4.47
8	Chemichal content of wood and bark eaten (5 - 7)	26.88	18.75	8.13	0.53	2.55

Table 2. Chemical components were digested by *Xystrocera festiva* larvae

No	Part of tree	Chemical components (%)					
		Holocellulose	Cellulose	Hemicellulose	Strach	Protein	Lignin
1	Sapwood	70.12	32.96	37.16	3.10	7.02	29.88
2	Larvae frass	10.98	7.66	3.32	0.22	1.04	29.88
	Digested by larvae	84.33	76.75	91.06	93.01	85.16	0.00

Table 3. Composition artificial diet for *Xystrocera festiva*

Composition	Dosage made by each researcher				
	Wibisono (1999)			Marta (2005)	Carvallo (2008)
	Rations 1	Rations 2	Rations 3		
Distilled water (ml)	600	600	600	450	30
Sucrose (g)	20	20	20	5	1.5
Streptomycin (g)	1	1	1	0.5	0.15
Cellulose flour (g)	20	20	20	5	0
Dust of fresh and dry sengon wood (g)	20	20	20	5	4,5
Agar (g)	7	7	7	1.75	0.525
Ascorbic acid (g)	0	2	0	0.25	0.1
Yeast extract (g)	0	0	6	1.5	0.25
Benzoat (g)	0	0	0	0.5	0.15
Dolomit (mg)	0	0	0	0	0.27
NaCl (g)	0	0	0	0	0.09
Zaitun oil (ml)	0	0	0	0	1.2
Vitamin B complex (mg)	0	0	0	0	0.6

4. CONCLUSIONS

Conclusions of this study are the wood chemical component of part of sengon tree that are mostly digested by *X. festiva* larvae was starch (93.01%) and hemicellulose (91.05%), however not all of the wood components can be digested by *X. festiva* like lignin.

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