JOURNAL

Constructing Audio Integrated Pest Management Using Spesific Sound Spectra of *Gamelan Blaganjur* Based on Balinese *Usada Carik* Transcript

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UNIVERSITAS NEGERI YOGYAKARTA
2015

Constructing Audio Integrated Pest Management
Using Spesific Sound Spectra of *Gamelan Blaganjur*
Based on Balinese *Usada Carik* Transcript

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Abstract

Indonesia is a country where she has hundred of ethnics. Balinese have a long history of using traditionally ritual activities for pest management, but recently modern science has taken it over. Traditional biological control is slowly finding its place in modern pest management. It is locally available and culturally acceptable. *Usada Carik* is Balinese traditional integrated pest management knowledge, where the people maintain paddy production. *Usada Carik* is Balinese transcript that refers to the practice of using sound of natural animals to protect rice field from mouse pest. *Nangluk mrana* is one of activities of pest management in which people use *gamelan blaganjur* as an instrument of source of sound. The objectives of research are as follows. Firstly to determine the kind of sound of gamelan blaganjur used in *nangluk mrana* ritual. Secondly to record the kind of sound and to transform into sonic bloom spectrum. Thirdly to determine the effect of certain peak frequencies of each sound to the mouse activities. The data of research (the recorded sounds) were obtained from field where the ritual activies happened. To determine peak frequency of sound of *gamelan blaganjur*, *Sound Forge* 6.0 software was used. The results of the research find; specific spectrum in peak frequencies uniqueness *gamelan blaganjur* spectrum instruments. The effect of sound of *cengceng* and *genta* were significant to mouse conditions, i.e decreasing of body weight, difficulty in nurshering, and increasing the death rate of baby mouse.

Key words: *Usada Carik Transcript*, spesific sound spectra, *gamelan blaganjur*

INTRODUCTION

A. Background

The usage of pesticide to control pest has some advantages, but it also brings some risks of degrading environment and health. *Usada Carik* is a system of rice production combined with pest control management found in Balinese farmers. The uniqueness of targeted pest and how to control them had been reported by Suryadarma (2008, p.35). The usage of the sound of *gamelan* as a means of chasing away field mice was based on the inherited belief of Balinese farmers. In order to better understand this matter, scientific investigation was needed by using the sound recording technology. *Nangluk mrana* or chasing away pest using *gamelan* instrument is one of ritual of Balinese farmers. The usage of *gamelan* instrument as source of sound needs a lot of work and can only be carried out collectively and sporadically.

That is why it is urgently needed an engineering to use recording sound as a part of a system to control pest routinely and with low cost. Sound of several instruments such as *kleneng* and *gamelan blaganjur* had been recorded by using voice recorder (2009, p 218) in *Wav* or *MP3* format. Sound files were then analysed using FFT to determine their peak frequencies and amplitudes (Suryadrama, 2013). Sound recording technology can then be used to change the frequency content and the exposure length of sound. The sound engineering could strengthen integrated pest control in line with deep ecology principles.

The saving and manipulation of peak frequencies and amplitudes of sound of *gamelan blaganjur* in the form of recorded sound had been reported by Suryadarma (2013). The uniqueness of frequencies of *gamelan blaganjur* and *cengceng* had been reported by Suryadarma (2013).

1. Sound Signal of *Gamelan Blaganjur* and *Cengceng*

Using *Fast Fourier Transform* (*FFT*) to analyse frequency contents of sound of *gamelan blaganjur* and *cengceng*, it turned out that *gamelan blaganjur* and *cengceng* had several dominant frequencies with high amplitudes. The profile of sound spectrum of *gamelan blaganjur* revealed that the *gamelan blaganjur* had two dominant frequencies at 549 Hz and 3008 Hz with the amplitude of 2.461% and 2.363%, respectively. *Cengceng* instrument had two dominant frequencies at 466 Hz and 2360 Hz with their respective amplitude at 3.984% and 4.064%. These dominant frequencies were used as principal variables of sound source that influenced the movement activites of mouse.

Research Purposes

This research had the purposes to obtain an engineering or modification of the recorded sound of *gamelan blaganjur* as a mean to control the activities of mouse. The specific purposes of the research was to know the effectivity of variables of peak frequencies and amplitudes as well as the duration of sound exposure as a mean to control the reproduction activities of mouse population.

Research Method

A. Time and Place of Research

The research was carried out between April and June 2014. The spectrum analysis of the sound of *gamelan blaganjur* and *cengceng* was carried out in Physics Laboratory. The exposure of manipulated sound of *gamelan blaganjur* and *cengceng* to mouse samples was conducted in Biology Laboratory of Yogyakarta State University

B. The Object of Research

The original sounds were obtained from the results of recording the sound of *cengceng* instrument and *gamelan blaganjur*. Mice used as the object of research were white mice that consisted of mother and baby mice. Frequency analysis and the synthesis of sound of *cengceng* instrument and *gamelan blaganjur* as sources of treatment sound were carried out using *Sound Forge* Pro 11.0.

C. Research Variables

The variables used in this research were:

1. **Independent Variables**

   Sound sources consisted of specific spectrum of *cengceng* instrument and *gamelan blaganjur.*

2. **Dependent Variables**

   Mouse activities and body weight of mouse, as well as the number of dead baby mouse.

D. Research Design

The research used recorded sound of *cengceng* instrument (selected at frequencies of 466 Hz and 2360 Hz) and *gamelan blaganjur* (at frequencies of 549 Hz and 3008 Hz) as sound sources. The recorded sound was then exposed to the mice for 40 minutes each day for 5 weeks in order to influence the breeding activity of mice at several group of ages.

Data Analysis Technique

The research used qualitative and quantitative analysis. Descriptive data were used to observe the mouse and baby mouse (*Rattus norvegicus*) activities during treatment where every treatment was repeated three times (P1, P2, P3). Quantitative data consisted of body weight of mouse, the amount of food consumed and the amount of faces at the end of observation.

RESULT AND DISCUSSION

A. Research Results

1. Body weight of mother mouse treated by using sound of *cengceng*

Table 1 showed the body weight of mother mouse treated by using sound of *cengceng* (P1: 466 Hz), repeated for three times, for five weeks and 40 munites of sound exposure daily.

Table 1. Body Weight of Mother Mouse Treated by Sound of *Cengceng* at 466 Hz

	PERLAKUAN											
	p1 (466 Hz) pemaparan 40 menit											
	1				2				3			
	Massa (gr)			Respon	Massa (gr)			Respon	Massa (gr)			Respon
Minggu	BSM	BK	BB	Visual	BSM	BK	BB	Visual	BSM	BK	BB	Visual
1	187		219,7		180,4		177,83		190,7		210	
2	161,46		200		157,3		160		172,08		200	
3	140,31	118,7	185,9		146,9	101	155		159,97	103,2	192,7	
4	118,35	113,8	139,9		100,18	96,3	147,3		122	105,1	200,5	
5	73,69	110,6	121,1		54,8	92,7	147,5		60,49	102,6	186,3	

The body weight of mother mouse started to decrease on the second week to the fifth week. The amount of body weight decrease (in grams) was as follows: repetition (1) 198.1 grams, repetition (2) 30.33 grams and repetition (3) was 23.7 grams.

The decrease in body weight for three repetitions follow the pattern below (see Figure 1)

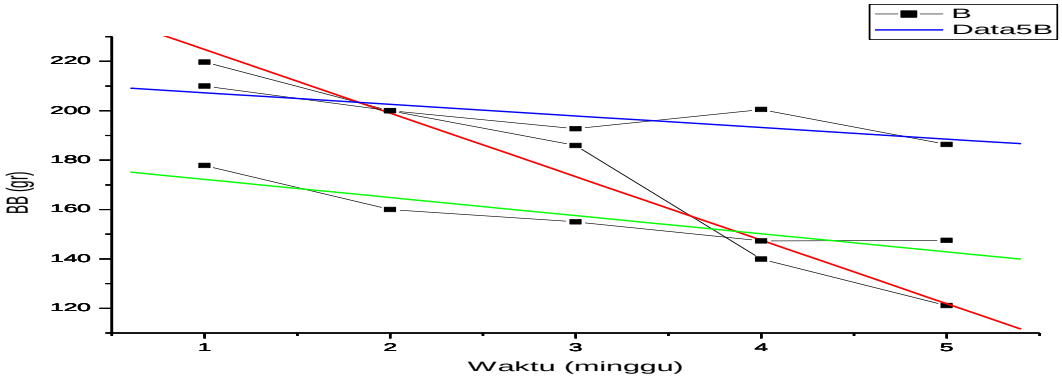

Figure 1. The decrease in body weight of mother mouse treated by sound of *cengceng* at 466 Hz. Note: Red line (repetition 1), green line (repetition 2), blue line (repetition 3)

Table 2 showed the decrease in body weight of mother mouse treated by sound of *cengceng* (P2: 2369 Hz) (for 5 weeks) (exposed for 40 munites daily).

The decrease in body weight of mother mouse was as follows: 60.7 grams for repetition (1), 42.2 grams for repetition (2) and 20.0 grams for repetition (3).

Table 2. Body Weight of Mother Mouse Treated by Sound of *Cengceng* at 2369 Hz

	PERLAKUAN											
	P2 (2360 Hz) pemaparan 40 menit											
	1				2				3			
	Massa (gr)			Respon	Massa (gr)			Respon	Massa (gr)			Respon
Minggu	BSM	BK	BB	Visual	BSM	BK	BB	Visual	BSM	BK	BB	Visual
1	177,5		226,5		181,02		276		178,9		170,59	
2	158,1		220		169,23		260		144,78		160	
3	144	91	161,4		160,35	92,7	247,9		139,95	95,1	147,9	
4	113,1	89,9	165		127,9	93,4	246,2		102,12	93	154,7	
5	69,1	88,3	165,8		52	100,6	233,8		49,9	97,2	150,9	

The pattern of the decrease in body weight of three repetitions was shown in Figure 2.

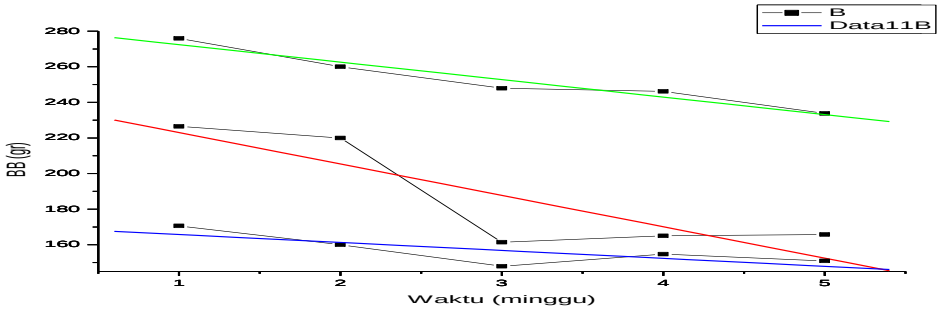

Figure 2. The graph of the decrease in body weight of mother mouse treated at 2369 Hz
Note: Red line (repetition 1), green line (repetition 2), blue line (repetition 3)

Increament in body weight was found at mother mouse of control group (P3) started at the second week through the fifth week and at three repetitions. The increament of body weight was as follows: repetition (1) was 15.43 grams, repetition (2) 10.8 grams and repetition (3) 9.43 grams.

Table 3. Body Weight of Mother Mouse of Control Group (P3, without treatment)

	KONTROL											
	1				2				3			
	Massa (gr)			Respon	Massa (gr)			Respon	Massa (gr)			Respon
Minggu	BSM	BK	BB	Visual	BSM	BK	BB	Visual	BSM	BK	BB	Visual
1	149,1		156,77		138,92		147		152,08		194,6	
2	128		169,5		120,63		151,9		132,2		198,7	
3	101,26	82,1	157,5		99	91	140,9		107,53	93,4	187,4	
4	69,8	91,5	165,9		50,31	101,9	198,2		76	95,9	146,2	
5	45,22	107,4	172,2		37,05	114,6	157,8		41,77	97	204,03	

Figure 3 shows the increament of body weight in three repetitions.

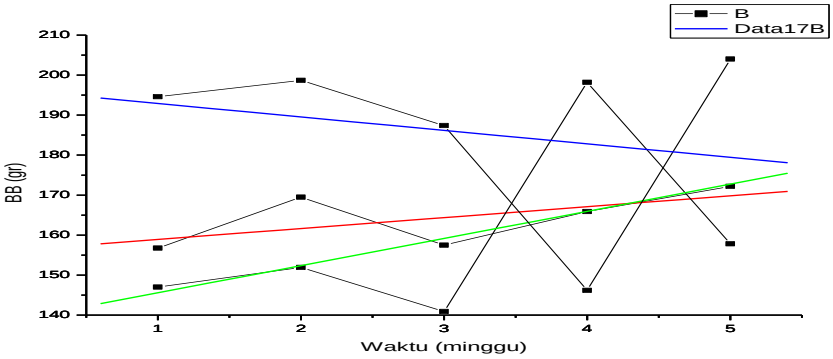

Figure 3. Graph of body weight increament of mother mouse of control group
Note: Red line (repetition 1), green line (repetition 2), blue line (repetition 3)

2. Body weight of baby mouse treated by sound of *cengceng*

Table 4 shows the body weight of baby mouse treated by sound of *cengceng* at frequency of 466 Hz (P1, 466 Hz)

Table 4. Body weight of baby mouse treated by sound of *cengceng* (P1, 466 Hz)

	PERLAKUAN											
	p1 (466 Hz) pemaparan 40 menit											
	1				2				3			
	Massa (gr)			Respon	Massa (gr)			Respon	Massa (gr)			Respon
Minggu	BSM	BK	BB	Visual	BSM	BK	BB	Visual	BSM	BK	BB	Visual
1	187		19,84		180,4		8,61		190,7		10,2	
2	161,46		29,35		157,3		13,18		172,08		16,28	
3	140,31	118,7	30,26		146,9	101	14,95		159,97	103,2	20	
4	118,35	113,8	36,1		100,18	96,3	22,35		122	105,1	22,36	
5	73,69	110,6	42,9		54,8	92,7	30,31		60,49	102,6	31,62	

The body weight of baby mouse increased for all three repetitions. The increment of repetition 1 was 23.06 grams, repetition 2 was 21.70 grams and 21.42 grams for repetition 3. The graph of three treatments is shown in Figure 4.

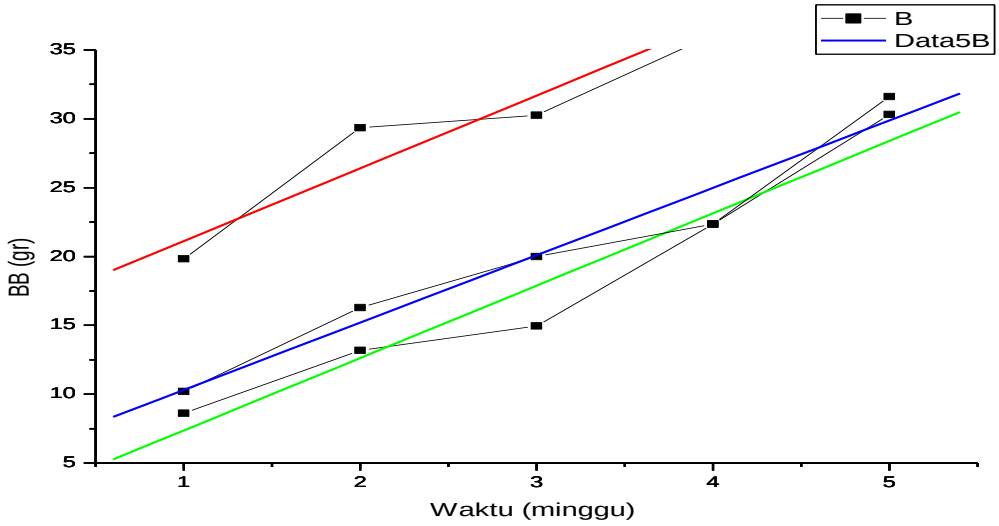

Figure 4. Graph of body weight increment of baby mouse treated by sound of *cengceng* at 466 Hz
Note: Red line for repetition 1, green line for repetition 2, blue line for repetition

3. Body Weight of Mother Mouse Treated by Sound of *Gamelan Blaganjur*

a. Treated at frequency of 550 Hz (P1: 550 Hz)

Table 7 shows the body weight of mother mouse treated by sound of *gamelan blaganjur* at frequency of 550 Hz.

Table 5. Body Weight of Mother Mouse Treated by Sound of *Gamelan Blaganjur* at 550 Hz (P1:550 Hz)

1				2				3			
Massa			Respon	Massa			Respon	Massa			Respon
BSM	BK	BB	Visual	BSM	BK	BB	Visual	BSM	BK	BB	Visual
171,39		170,2		170		148,9		178,32		194	
169,4		164		160,03		135,9		159,8		173	
154,7	99,1	150		146	93	137,6		152,55	84,9	174,6	
116	94,9	153,2		103,73	89,2	128,3		119,47	96	169,7	
79,05	88,8	157,7		58,3	97,9	118,1		44,33	74,1	155,7	

The body weight of mother mouse turned out decreasing started from the second week through the fifth week. The decreament was 12.5 grams for repetition 1, 29.80 grams for repetition 2 and 38.30 grams for repetition 3.

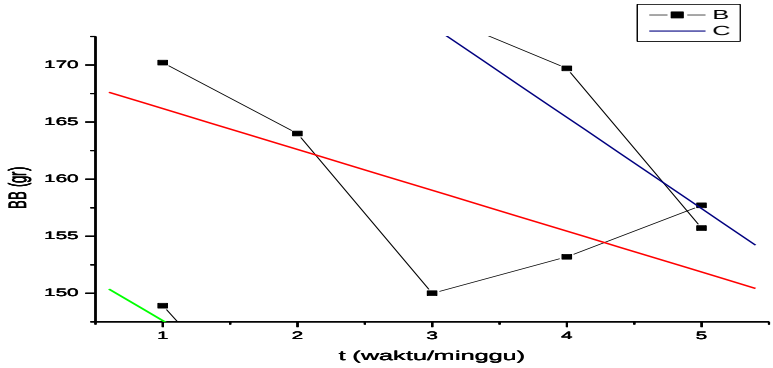

Figure 5. Graph of the decreament of body weight of mother mouse treated at 550 Hz (P1:550 Hz)
Note: Red line for repetition 1, green line for repetition 2, blue line for repetition 3

b. Treated by Sound of *Gamelan Blaganjur* at Frequency of 3000 Hz

Table 6. Body Weight of Mother Mouse Treated at 3000 Hz (P2: 3000 Hz)

1				2				3			
Massa			Respon	Massa			Respon	Massa			Respon
BSM	BK	BB	Visual	BSM	BK	BB	Visual	BSM	BK	BB	Visual
169,04		168,24		172		190		184,64		172	
146,96		140		168,9		186		166,81		160	
131,5	90	140,9		147,4	82,3	178		138,2	87	138,1	
111,1	78,3	150,7		101,6	88	180,4		104	91,2	153,8	
66,81	94	160,7		61,81	85,2	188		57,07	95,9	152	

The body weight of mother mouse treated by sound of *gamelan blaganjur* at frequency of 3000 Hz was decreasing, started at the second week through the fifth week. The decreament was 7.54 grams for repetition 1, 2.0 grams for repetition 2 and 20.0 grams for repetition 3.

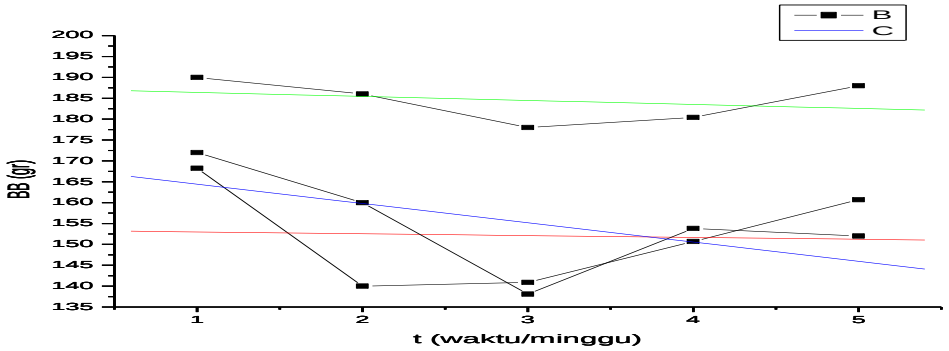

Figure 6. The decreament of body weight of mother mouse treated at 3000 Hz (P2, 3000 Hz)
Note: Red line for repetition 1, green line for repetition 2, blue line for repetition 3

c. Body Weight of Mother Mouse of Control Group

Table 7. Body Weight of Mother Mouse of Control Group (P3:without treatment)

1				2				3			
Massa			Respon	Massa			Respon	Massa			Respon
BSM	BK	BB	Visual	BSM	BK	BB	Visual	BSM	BK	BB	Visual
149,1		156,77		138,92		147		152,08		194,6	
128		169,5		120,63		151,9		132,2		198,7	
101,26	82,1	157,5		99	91	140,9		107,53	93,4	187,4	
69,8	91,5	165,9		50,31	101,9	198,2		76	95,9	146,2	
45,22	95,9	172,2		37,05	114,6	157,8		41,77	97	204,03	

Body weight of mother mouse of control group turned out increasing started from the second week through the fifth week for all three repetitions. The increament of body weight was 15.43 grams for repetition 1, 10.8 grams for repetition 2 and 9.43 grams for repetition 3.

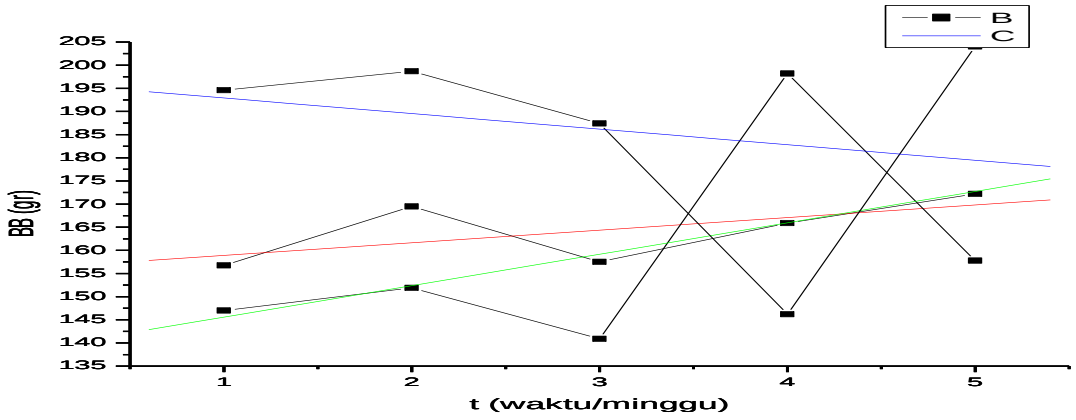

Figure 7. Increament of body weight of mother mouse of control group (P3)
Note: Red line for repetition 1, green line for repetition 2, blue line for repetition 3

A. Discussion

Based on the data of the results of treatment (sound exposure of *gamelan blaganjur* and *cengceng* instrument) to influence the activities of mother and baby mice, the obtained data could be explained as follows.

1. Body Weight of Mother Mouse

The body weight of mother mouse, treated using sound of *cengceng* and *gamelan blaganjur* at all frequencies, decreased, started from the second week through the fifth week. Contrary to this fact, the body weight of mother mouse of control group turned out increasing for all repetitions.

The decrement of body weight of mother mouse had correlation with the amount of food consumed and the total weight of mouse feces. The volume of food consumed should be proportional to the body weight of mouse, or at least the body weight of mouse did not decrease. The decreament of body weight could be related to the observed movement of the mouse, i.e. the random and very active movement. The random and very active movement resulted in lowering probability to consume food and part of the energy of the consumed food was used in movement activity as entropy, and not used to increase body weight.

2. Visual Activity of Mice

Visual activity of mouse movement was obtained through video recording and photographs taken during the period of treatment and sound exposure. Visual data of mouse movement could be classified into normal, active and very active; the pattern of movement was regular and random. That the movement of treated mouse was very active and random could be observed from several indicators: the mouse put it its head under the base of the cage that consisted of dried rice stalks and shaving of wood; mother mouse scratched its legs to the media of base of cage; mother mouse left its baby mice when the baby would suckle on its breast. The movement of treated mother mouse (P1, P2) was very different from the movement of mother mouse of control group (P3). The movement of treated mouse indicated that the sound exposure of *gamelan blaganjur* and *cengceng* instrument caused the mouse under pressure or stress.

3. Visual Activity of Baby Mice

Movement activities of baby mice exposed to the sound of *cengceng* instrument and *gamelan blaganjur* showed some facts as follows: baby mice tried to catch their mother in order to breast feeding, but their mother tried to avoid them; baby mice scratched their legs and put in their heads under the media of base of cage. The number of treated baby mice that were dead at the end of the forth week was 70%. The death rate of the control baby was 15%.

CONCLUSION AND SUGGESTION

Based on the analysis of data and the discussion, it can be drawn some conclusions as follows:

1.The recorded sound of *gamelan blaganjur* and *cengceng* instrument analysed and selected at certain peak frequencies could be used as sound sources.

2.The exposure of synthesised sound of *gamelan blaganjur* and *cengceng* instrument for 40 minutes a day and for 5 weeks disturbed the movement activities of mouse. This disturbance was decreasing the number of population of mouse and in line with the integrated control of pest management.

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