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Preferences of Krepes Disease-Causing Mites Related to Nutritional Content in Edible Mushrooms

Catarina Aprilia Ariestanti[1*], Jovita Lavenia[1], Mentari Noviyanti Putri[1], Fransiska Thea Setyaratri[1]

[1]Faculty of Biotechnology, Duta Wacana Christian University, Jalan Dr. Wahidin Sudirohusono no. 5-25, Gondokusuman, Yogyakarta 55224, Indonesia

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***Corresponding author:** Catarina Aprilia Ariestanti
Faculty of Biotechnology, Duta Wacana Christian University, Jalan Dr. Wahidin Sudirohusono no. 5-25, Gondokusuman, Yogyakarta 55224, Indonesia

Abstract | **Original Research Article**

Edible mushrooms are highly cultivated by mushroom farmers in Sleman, Daerah Istimewa Yogyakarta, Indonesia because of its nutrition content that have benefit for health. The problem facing by the farmers is related with the disease caused by mites, locally called krepes. This research aims to study the variation of edible mushrooms which can be the host for the mites and its effect on the nutrition quality of the mushroom. Mites were inoculated into the mushroom baglog. The temperature and humidity were controlled during the mushroom's growth. Proximate analysis was conducted to know the nutrition composition of the mushroom. The result showed that mites which caused krepes only growth in ear mushroom (Auricularia auricula) that has carbohydrate composition of 28.69%, the highest among edible mushrooms studied in this research. Generally, there were decreasing value in carbohydrate and protein composition with increasing value of water content in the edible mushrooms inoculated with the mites. Further study to investigate the specific type of carbohydrate used by the mites should be performed.

Keywords*:* Mites, krepes disease, edible mushroom, nutrition.

INTRODUCTION

Since early of 2000s, Sleman Regency, Daerah Istimewa Yogyakarta (DIY) Province has been pioneering to be a central location for edible mushrooms cultivation such as ear mushrooms (*Auricularia auricula*), white oyster mushrooms (*Pleoratus ostereatus*) and ligzhi mushrooms (*Ganoderma lucidum*). Ear mushroom cultivation was formerly being a superior product of farmers in those areas, with widely marketing up to outside DIY Province. However, the cultivation of ear mushrooms was constrained by fungal fruiting body rot, as locally called krepes disease. According to Hubert (2012) krepes disease is a disease on some products caused by a group of small animals called mites that belong to the Acari subclass. Several studies found that Tyrophagus genus which is belongs to Acari family, played an important role and was the major caused of krepes disease that were common in the mushroom industries. Those Tyrophagus genus caused fungal fruiting body rot and prevents mycelium growth to produce new fruiting bodies (Jeong *et al.*, 2007; Li *et al.*, 2003).

According to Duek *et al.*, (2001), a species of Tyrophagus genus, *Tyrophagus putrescentiae*, was very common to be found in fungal and insect cultures in the laboratory. The effects of Tyrophagus genus have been caused huge losses in the ear mushrooms cultivation industry, because the mushroom baglogs produced damage ear mushrooms that were not feasible for consumption. Further negative effect of this krepes disease was that the mycelium of the ear mushroom was no longer be able to produce fruit bodies. Due to the high losses caused by krepes disease, many mushroom farmers eventually switched to cultivate other kinds of edible mushrooms, especially oyster mushrooms which gained attention form the consumers. Button mushrooms (*Agaricus bisporus*), shiitake mushrooms (*Lentinus edodes*), oyster mushrooms (*Flammulina velutipes*), and ear mushrooms (*Auricularia auricula*) are the most widely cultivated types of edible mushrooms (Valverde *et al.*, 2015).

Research conducted by Qu *et al.*, (2015) showed that *Tyrophagus* sp. were able to utilize shiitake mushrooms, buttons, white and brown oyster, and lingzhi as their hosts during mushrooms cultivation.

The mites of *Tyrophagus* sp. showed the ability to survive for 31 days without food under humid condition of 20-25^{0}C (Sass & Wyatt, 2006). Thus, there were a possibility that these mites might be able to grow and use other types of edible mushrooms as their hosts. Therefore, observation on the possible hosts for *Tyrophagus* sp. in the mushroom cultivation areas is important to be conducted to understand the possibility of certain cultivated mushrooms being attacked by the mites. Nutritional analysis of contaminated mushrooms is also needed to determine the nutrient content used by the mites-caused krepes disease in host selection. The purpose of this study was to learn the range of cultivated mushrooms that can be used as a host for the mites-caused krepes disease and to learn its effect on the nutritional quality of the mushrooms as an information about nutritional value of contaminated mushrooms especially for farmers and consumers. The results of this study were expected to provide information on the preferences of krepes pests to use cultivated mushrooms as their hosts based on the utilization of mushrooms nutrient content.

MATERIALS AND METHODS

Materials

The materials used in this research were F1 seeds of white oyster mushrooms (*Pleuratus ostreatus*), pink oyster mushrooms (*Pleuratus Flabellatus*), and lingzhi mushrooms (*Ganoderma lucidum*) obtained from CV. Media Agro Merapi, Cangkringan, Sleman, Daerah Istimewa Yogyakarta. Baglog exposed by krepes pest as a source of isolate mites was obtained from mushroom farmer in Ngipiksari, Cangkringan, Sleman, Daerah Istimewa Yogyakarta.

Methods

Mites Breeding

The mites were isolated from ear mushrooms baglog of Cangkringan mushroom farmers that were infected by krepes disease. The mites were maintained directly through aseptic inoculation into fruit bodies of ear mushrooms that grows in mushroom baglog. Optimalization of mites breeding was performed according to research that was done by Madyaningrana & Apra (2021).

Determination of preference hosts

The mites were inoculated on white oyster mushrooms (*Pleuratus ostreatus*), pink oyster mushrooms (*Pleuratus Flabellatus*), and lingzhi mushrooms (*Ganoderma lucidum*) that were ready to produce fruit bodies. Mushroom baglog were maintained under the control of environmental parameters such as air humidity and temperature. All of the process was performed in the mushroom house of Faculty of Biotechnology, Duta Wacana Christian University. Mushrooms were harvested periodically, weighed and preserved in the freezer for further nutritional content examination. Observations were made for 3 months.

Nutritional content analysis

Proximate analysis to determine the nutritional content of cultivated mushrooms was performed in the laboratory of Food and Nutrition Center Studies, Gadjah Mada Univeristy, Yogyakarta, Indonesia. Calculation of nutritional content included the percentage of moisture, protein, fat, ash, and carbohydrate in the mushrooms. Analysis was carried out for both mushrooms affected by krepes disease and healthy mushrooms. The moisture content was measured by gravimetry method using an oven at 100-105^{0}C until reached its constant weight. The protein content was measured by Kjeldahl method. The fat content was measured by Soxhlet method with Weibull modification. The ash content was measured using gravimetry method by heating the sample at 500-550^{0}C. The carbohydrate content was calculated by subtaracting the number 100 with the total percentage of the result measurement of water, protein, fat and ash content.

RESULTS AND DISCUSSION

The mites are inoculated into each mushroom baglog that was ready to produce fruit bodies. The growth of the mushrooms was observed for 3 months. Air temperature and humidity in the mushroom house Faculty of Biotechnology were controlled to make it suitable for the growth of mushrooms. Temperature and humidity were maintained by spraying mushroom house using sprayer twice a day. The harvesting process was performed on fruit bodies mushrooms that were ready to be harvested. The result of temperature and humidity during the study inside the mushroom house were shown in Table 1.

Table 1: Humidity (H) and air temperature (T) inside the mushroom house

Month 1		Month 2		Month 3	
T (°C)	H (%)	T (°C)	H (%)	T (°C)	H (%)
28	52	29	65	30	72
24	65	30	67	28	70
28	55	30	62	27	63
32	53	29	68	30	60
31.5	67.5	28.5	72.5	29	63

Month 1		**Month 2**		**Month 3**	
T (°C)	**H (%)**	**T (°C)**	**H (%)**	**T (°C)**	**H (%)**
30	68	29	68	28	65
28	70	30	65	29	70
28	62	31	60	30	76
29	48	31	57	30	85
28	52	32	53	28	85
31	50	30	58	28	80
27	60	29	56	30	75
30	68	28	60	30	70
31	60	30	62	30	70
30	69	31	60	27	60
30	60	32	60	25	70
30	54	30	63	25	72
30	59	29	64	26	75
28	74	29	62	25	73
30	70	28	70	25	70
31	80	27	70	27	64
34	48	24	80	23	70
30	58	27	75	25	70
32	60	32	46	28	72
28	53	33	55	30	75

The average air temperature inside the mushroom house was 28.9^0C with the humidity value of 65.2%. Spraying process made the mushroom house conditions were suitable for the growth of mycelium and fruit bodies. The temperature range in this study was still higher than the temperature value from the study by Ahmad *et al*., (2013). This may be due to the dry season that occurred during this study. Air humidity in this study was consistent with the result obtained by Chang & Philip (2004) and Li *et al*., (2015) which stated that the range of air humidity during the growth of the mushroom was about 60-97%.

Ready to be harvested mushroom bodies were collected during the time of observation. Harvested mushrooms were weighed and checked for the existence mites. The results showed that krepes pests only grow on the fruit bodies of the ear mushroom, which was characterized by the presence of white dot-shaped bubbles between the fruit bodies of the ear mushroom (Fig 1). Those mite groups were not found in the fruit bodies of other types of mushrooms in this study. Krepes pests only grow on ear mushroom, and it may because of the different nutrient content of each mushroom so the mites only aaperared on one type of mushroom by using a certain nutrient to support their growth. The research from Madyaningrana & Apra (2021) showed that the mites caused krepes disease preferred to grow on ear mushroom baglogs covered by mycelium or basidiocarp as its growth medium. According to our study, the results also showed that there were no mites on the fruit bodies of other edible mushrooms that has been cultivated together inside the mushroom house.

Figure 1: The mites group on ear mushroom

In this study, nutritional contents of the mushrooms were tested by proximate analysis for its water, ash, fat, protein and carbohydrates percentage. The results were obtained for treated mushrooms that infected by krepes disease-causing mites and the untreated mushrooms (control). The result shown in Table 2.

Table 2: Result of proximate analysis on several edible mushrooms

Type of mushroom		Nutritional Content (%)				
		Water	Ash	Fat	Protein	Carboydrate
Ear	Control	64.97	1.12	0.73	4.51	28.69
	Treatment	77.39	0.71	0.54	2.68	18.69
Lingzhi	Control	75.33	0.43	0.08	3.51	21.26
	Treatment	70.57	0.47	0.16	3.62	25.19
Pink oyster	Control	80.22	1.29	0.37	5.16	12.98
	Treatment	84.17	1.14	0.40	4.05	10.25
White oyster	Control	89.38	0.73	0.26	2.35	7.30
	Treatment	93.99	0.43	0.14	1.57	3.38

The results of proximate analysis showed that carbohydrate content of the untreated ear mushrooms was higher than other types of mushrooms (28.69%). The carbohydrate and protein content of ear mushrooms treated with mites decreased by 10% and 1.83%, respectively. The results indicated that the mites utilized carbohydrate and protein content of ear mushrooms to support their growth. Our result was in accordance with the research done by Suryani & Harjaka (2007). Itisha *et al.*, (2017) found that protein content from the mushrooms was affected the growth of mites because they are a pest that can grow well on high-protein foods. This is similar to our results. The carbohydrate and protein content of edible mushrooms showed to have benefits as immunomodulators, antioxidant, and anti-cancer agents (Xu *et al.*, 2011; Khan *et al.*, 2013). The moisture content of mites-treated ear mushroom was increased compared to control. This happened because krepes pests decayed the fruit body, which resulted in the increasing of ear mushrooms moisture content. Due to the mites has infected the ear mushrooms, nutritional value was decreased and there were changes in its texture. Decayed and even stunted growth of cultivated mushrooms will cause economic losses to mushroom farmers because the mushrooms were not suitable to be consumed and released into the market.

All of the edible mushrooms in this study showed a fairly high in carbohydrate content. However, there may be differences in the types of carbohydrate composition because only in the ear mushroom that the mites grow and affected its carbohydrate content. More research needs to be performed to determine the carbohydrate type of each edible mushroom so that it can provide more specific nutritional information that can support the grow of krepes disease-causing mites, thereby preventing krepes disease especially in the cultivation of ear mushrooms. It is important to prevent krepes disease in the edible mushrooms because of mushrooms provided various health benefits to human.

CONCLUSION

The absence of mites on other edible mushrooms but ear mushrooms suggested that the pest causes krepes disease has a particular host. The nutritional contents that were widely used for mites breeding were carbohydrate and protein. Further research needs to be performed to discover the preference of carbohydrate in edible mushrooms to be used by the mites to support their grow.

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