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Diversity of indigenous fungi during ruminant feed fermentation made of water hyacinth *(eichhornia crassipes)* and corn *(zea mays)* cob

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This research aim to know the fluctuation of fungi community for 15 days of fermentation process. The procedure passed consisted of fungi isolation, purification and identification. Fungi identification was conducted using observation on the fungal macroscopic and microscopic character. Parameters of community ecology such as diversity, evenness, and dominancy were analyzed on this research. There were 10 fungi species, including *Aspergillus sp1, Rhizopus sp1, Aspergillus terreus, Mucor sp1, Aspergillus sp2, Aspergillus niger, Trichoderma sp1, Aspergillus flavus, Aspergillus sp3* and *Penicillium sp1*. The highest fungi diversity were in the thirth day, the highest evenness occured at the thirth and tenth day fermentation process. All of the fungi species were dominant during fermentation. In the next research the indigenous bacteria community fluctuation will be displayed as a continuing this research.

Keywords: indigenous fungi, community fluctuation, fermentation, water hyacinth, corncob

INTRODUCTION

Recently, the feed stock especially the cheap and nutritious feed has be a main problem in farming. This feed can be produced through fermentation process by utilizing farm-waste and weeds materials. In this research fermented feed is made from corncob and water hyacinth as the main material.

Corncob is potential to be used as livestock feed because it contains 5,6% protein, higher than the protein concentration in rice-straw (4,9%) (Belal, 2014). Researchers had been utilized corncob as livestock feed, such as corncob powder had made by Sumaoang and it becomes favourite food for pigs, goats and poultries (Sarian, 2016). On the other research, corncob were used as buffalos feed (Wanapat, et al., 2012) , fish feed (Rostika and Safitri 2012) and ruminant feed (Lardy and Anderson 2009).

Difficulties of digestion corncob is a weakness of utilize as feed material (Kanengoni, et al., 2015). Because of that, the material needs processing and addition other materials before used as feed. The suitable added material is water hyacinth (*Eichhornia crassipes*). Water hyacinth can grow very fast (Tham, 2012), contains high protein around 11.87%, high calcium and phosphorous, also can stimulate the milk production if it combined with suitable concentrate (Kumar, et al., 2011). Unfortunately, water hyacinth contains a very high rough fiber, water, and difficult digested protein (Saputro, 2016). This problems can solve by fermentation.

Water hyacinth fermentation process can be conducted by using A*spergillus niger* (Saputro, 2016), and *tempeh* yeast (Fitrihidajati et al., 2015). Water hyacinth were fermented with *tempeh* yeast increased the goat bodyweight (Fitrihidajati et al., 2015) and increased protein

content of goat meat (Suparno et al., 2015). The advantages of fermented feed are high nutrient concentration, high digestibility, and high palatibility (Seo, et al., 2015).

The fermentation process involves bacteria and fungi. The rate of fermentation process depends on some factors, mainly the compatibility of microbes with materials that will be fermented. It means that fermentation process using certain materials will have specific and selected microorganisms (Boboescu et al., 2014). The specificity of microbes enzyme were play role in fermentation of specific materials . The diversity of indigenous microorganisms in every fermentation phase should be determined, in order to create a suitable starter consortium.

Fungi were involved in fermentation process with water hyacinth and corncob mixture as feed materials unknown. The knowledge about fungi species related in fermentation process of certain materials are very essential to increase the rate and quality of fermentation result. This research investigate the fluctuation of fungi in fermentation process from day to day. The diversity, evenness, and dominancy of fungi species will be analyzed.

MATERIALS AND METHODS

The feed was made by some stages: Water hyacinth and corncob were cutted, then dried. Dry materials were steamed, then mixed with ratio 1:1. After that, the mixture were incubated in order to naturally fermentation process (Fitrihidajati, et al., 2015). Everyday during fermentation process, the indigenous fungi was isolated by taking 30gr materials randomly, then was suspensed in sterile aquades, filtered, and cultured by pour plate method. Potato Dextrose Agar (PDA) for Microbiology (Merck) was used as the media culture. Then, the culture was incubated in 37°C temprature for 4-7 days.

After 4-7 days incubation, the culture was purified by streak plate method, then incubated for 4-7 days again to get the pure culture. The pure culture was identified by macroscopic and microscopic characters. This identification give information of indigenous fungi diversity. Index of diversity, index of evennes, and index of species richness was calculated.

RESULTS AND DISCUSSION

The result presented in Table 1 as follow.

Based on Table 1, from day to day there were different diversity, evenness, and species dominancy. By using culture method in potato dextrose agar, ten fungi species was successfully isolated, consisted of *Aspergillus sp1*, *Rhizopus sp1, Aspergillus terreus, Mucor sp1, Aspergillus sp2, Aspergillus niger, Trichoderma sp1, Aspergillus flavus, Aspergillus sp3,* and *Penicillium sp1*.The highest fungi diversity were in the thirth day, the highest evenness occured at the thirth and tenth day. All of the fungi species were dominant during fermentation.

Feed materials consist of mixture water hyacinth and corncob that contain high cellulose. Because of that, the indigenous fungi had been isolated from this material were dominated by fungi which have cellulolytic activity. The number of species increased day by day, and at the end of fermentation process there are five species of fungi. Based on fungi diversity data during fermentation process as in Table 1, *Aspergillus sp1* and *Rhizopus sp1* have been detected the presence in all of day of fermentation process. The presence of that fungi indicate signal that the two species could utilize the cellulose degradation as the energy and carbon sources (Alruman, 2016). It was different from *Aspergillus flavus, Aspergillus sp3* and *Penicillium sp1* which presence at the end of fermentation process.

The indigenous fungi diversity that involved in fermentation process of water hyacinth and corncob mixture were different from day to day. The diversity of indigenous fungi consist of species variation, and the numbers of fungi that grow in those materials. The overall fungi diversity during fermentation process were classified low (Shannon-Wiener index of diversity value = 0.8721). This indicated that during fermentation process of water hyacinth and corncob mixture there was not a big species diversity of fungi, only a few fungi species involved in the fermentation process. The index of evenness each fungi about 0,3787 was categorized low. This indicated that the fungi species diversity were not distributed, only certain fungi species involved in the fermentation process. All of the fungi species are dominant species during fermentation process. Ramos et al., (2011) state that each different phase fermentation (mesophylic, termophylic, cooling and maturing) has different microorganisms and involve some kinds of bacteria and fungi.

In summary, fermentation process of the mixture of water hyacinth and corncob involved ten fungi species including Aspergillus *sp1, Rhizopus sp1, Aspergillus terreus, Mucor sp1, Aspergillus sp2, Aspergillus niger, Trichoderma sp1, Aspergillus flavus, Aspergillus sp3* and *Penicillium sp1*.

Table1. Diversity, evenness, and dominancy index daily of fungi species during water hyacinth and corncob mixture fermentation process

Day of fermentation	Total number of fungi	Diversity index	Evenness index	Dominancy
1	133	0,1520	0,2193	*Aspergillus sp1(51,13%)* *Rhizopus sp1 (48,87%)*
2	149	0,3004	0,4334	*Aspergillus sp1 (52,69%)* *Rhizopus sp1(47,32%)*
3	220	1,0884	0,9907	*Aspergillus sp1 (45%)* *Rhizopus sp1(37,73%)* *Aspergillus terreus (17,27%)*
4	230	0,4489	0,4086	*Aspergillus sp1 (48,48%)* *Rhizopus sp1(37,17%)* *Aspergillus terreus (19,35%)*
5	194	0,2996	0,4323	*Aspergillus sp1 (54,12%)* *Mucor sp1 (45,88%)*
6	282,5	0,5785	0,4173	*Aspergillus sp1 (34,87%)* *Rhizopus sp1(30,97%)* *Aspergillus terreus (15,04%)* *Aspegillus sp2(19,12%)*
7	284,5	0,5923	0,4273	*Aspergillus sp1 (27,94%)* *Rhizopus sp1(31,11%)* *Aspergillus terreus (17,22%)* *Aspegillus sp2(23,73%)*
8	279	0,5901	0,4257	*Aspergillus sp1 (27,78%)* *Rhizopus sp1(29,57%)* *Aspergillus terreus (15,41%)* *Aspegillus sp2(27,24%)*
9	178	0,4549	0,4141	*Aspergillus sp1 (36,80%)* *Rhizopus sp1(43,82%)* *Aspergillus niger (19,38%)*
10	166,5	0,4772	1,5758	*Aspergillus sp1 (33,63%)* *Rhizopus sp1(32,73%)* *Aspergillus niger (47,50%)*
11	161	0,4767	0,4339	*Aspergillus sp1 (31,37%)* *Rhizopus sp1(33,85%)* *Aspergillus niger (34,78%)*
12	120,5	0,3009	0,4341	*Rhizopus sp1(48,55%)* *Aspergillus niger (51,45%)*
13	321,5	0.6974	0,4333	*Aspegillus terreus (17,57%)* *Aspergillus sp2 (20,68%)* *Aspegillus flavus (19,60%)* *Aspergillus sp3 (22,86%)* *Penicillium sp1 (19,29%)*
14	295,5	0,6853	0,4258	*Rhizopus sp1 (11,17%)* *Aspegillus terreus (19,46%)* *Aspegillus flavus (21,15%)* *Aspergillus sp3 (23,86%)* *Penicillium sp1 (24,37%)*
15	302	0,6933	0,4308	*Rhizopus sp1 (15,73%)* *Aspegillus terreus (18,05%)* *Aspegillus flavus (25,66%)* *Aspergillus sp3 (20,70%)* *Penicillium sp1 (19,87%)*

The diversity, evenness, and dominancy of related fungi in those fermentation materials from day to day are various. The highest diversity was on the thirth day, while the highest evenness occured at the thirth and tenth days. All of fungi species were dominant during fermentation process.

CONCLUSION

Based on the research result obtained, there were fungi diversity, evenness, and dominancy fluctuation from day to day during fermentation. Therefore, in the utilization of fermented feed as indigenous fungi starter consortium, all the catched isolates had to be sponsored everyday.

CONFLICT OF INTEREST

Author declare that There is no conflict of interest .

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