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Recruitment And Ability Of Seed And Propagule To Grow In Mangrove Forest Segara Anakan Cilacap

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***Abstract*—** Segara Anakan mangrove forests are formed in the estuary of Segara Anakan, Cilacap enclosed by Nusakambangan Island. The forests area was 26 thousand square kilometers. In the last three decades the forests was damage due to illegal logging so that the forest area is covered by mangrove shrub of *Derris heterophylla* and *Acanthus illicifolius*. The proportion of mangrove trees is very low compared to mangrove bushes. If this situation continues, the diversity of mangroves in Segara Anakan will decline rapidly. This study aims to calculate seed and propagules production and assess the success living rate of 13 mangrove species in Segara Anakan. Purposive sampling method was applied in the data collection that was conducted in March, June, August, and November 2013. At each tree sample it was counted number of seeds and propagules, number of seedling and sapling. Descriptive statistics were used to analyze the differences between species. Results showed that each species has a different productivity of seeds and propagules, as well as the level of seedling recruitment and or sapling. Among the 13 studied species, *Bruguiera gymnorhiza, Bruguiera parviflora, Rhizophora mucronata, Xylocarpus molucensis, Ceriops tagal, Soneratia molucensis, Avicenia alba,* and *Nypha fruticans* have high productivity of seeds and propagules and good sapling recruitment. Meanwhile *Rhizophora apiculata, Aegiceras corniculatum*, and *Soneratia alba* have good productivity of seeds and propagules but it has a bad sapling recruitment. *Derris heterophylla* and *Acanthus illicifolius* in this study demonstrated the ability of the good seeds and propagules productivity but have low sapling recruitment. Based on these results it is concluded that most of the mangrove trees in Segara Anakan have high productivity of seeds and propagules and good sapling recruitment so that they have the ability to naturally restore the mangrove forest structure as long as the factors that damage the natural conditions can be minimized.

Keywords: *recruitment, mangroves, propagules, seedling, sapling, natural recovery*

I. INTRODUCTION

Mangroves are recognized as ecoton for connecting terrestrial ecosystems with marine ecosystems. Its vegetation has a unique structure (Lugo, 1974) because of its ability to function in environments with high salinity while at the same time have a high primary productivity. Mangrove ecosystem consisting of a compartment below the ground surface that consists of mud, roots of mangrove, mangrove floor fauna such as crabs, snails, worms; and compartment above the soil surface that consists primarily of mangrove trees with fauna that live in it like birds, worms, insects and reptiles. Primary energy comes from the sun, mangrove forests, and nutrients that come from the overflow of the river or the results of rainwater overflow (run-off). In this system two compartments are connected by a rotation through photosynthesis energy. Primary productivity of mangrove forests are in the form of leaves, branches, flowers and seeds that will fall to the ground and grow or eaten by mangrove floor fauna for further mineralized and returned to the ground. Many studies have been done to calculate the productivity of mangrove. Alongi (2001) stated that mangrove productivity reaches 300-400 t DW/ha. This productivity varies among species, location and season. *Avicenia marina* produce 6200 g DW/ha/year, *Rhizophora stylosa* produce 9650 g DW/ha/year and *Ceriops tagal* produce 6750 g DW/ha/year (Bunt, 1995). Primary productivity of mangrove forests in mono-specific forest is much lower than mixed vegetation forest (Twilley, 1986).

Mangrove ecosystems are also rich in fauna that help to build the forest structure on the floor of the mangrove. Mangrove crabs of the family Gecarcinidae, Ocypodidae and Sesarmae have a primary function to process the leaves and twigs that fall to the mangrove floor (Robertson 1986, 1989; Dahdouh-Guebas,

1998; Lee, 1998; Bouillon et al., 2002; Nordhaus et al., 2006). *Parasesarma leptosome* of the family Grapsidae and *Aratus pisonii* of family Sesarmidae apparently also likes to climb trees and eat mangrove leaves that still fresh (Linton, 2007). Mangrove crab floor helping the processes of decomposition of mangrove leaves. Nevertheless, crabs also eat seeds or propagules of mangrove fell to the floor. Not only that, some crabs even eat mangrove seeds that begin to grow into seedlings or saplings (Smith, 1987). Several studies have shown that the rate of consumption of the seeds or propagules by mangrove crab is much higher in the shade compared to open or hot spot. However, Imgraben (2008) found that mangrove propagules consumption by crabs is not significant. Further, Kraus (2003) found that predation of mangrove propagules by crabs is only 17% and did not differ between the shade and open place.

In addition to its unique structure, mangrove forests also have a very important function. Almost all of the fish that live in the open sea, coming to the mangrove areas which have brackish water and oxygen-rich to lay eggs and raise their offspring among the mangrove vegetation. Marsh birds such as coax night, grouse, herons, and kingfisher utilize mangrove areas for nesting and foraging. Mullet, shrimp and prawns into are source of income for fishermen in the mangrove areas. Structure of mangrove forests that have strong roots, both pneumatophore and roots and roots hanging knee proved to be a catastrophic tsunami breakwater (Dahdouh- Guebas , 2005).

Similar to other ecosystems, mangrove ecosystems are highly vulnerable to disturbance. Natural disturbances by insects apparently affect nutrient turnover in the mangrove forests of Belize (Feller, 2002). When attacked by a mangrove twig borer insect, quantity and quality of litter that falls to the floor mangrove changed. Similarly, disruption due to logging gaps or cracks also formed the beginning of the process of secondary succession in mangrove ecosystems (Das, 1985; Djohan, 2007). The results of several research studies indicate that the invading species, spread only when there is a breakdown of mangrove ecosystems (Biswas, 2007). Chronic disorders of the Sundarban mangrove ecosystem in India and Pakistan have significantly changed the composition of mangrove species and mangrove forest structure (Ameen, 1999; Biswas, 2003). Further studies showed that changes in abiotic environmental conditions after disturbance can alter species composition, species ability to withstand disturbances and recruitment patterns or the success of seeds and propagules grow into a seedling and sapling. (Baldwin, 2001; Clarke, 2000; Clarke, 2001; Piou, 2006).

Natural damage due to storms or lightning that create gap or gaps in the canopy of mangroves is not too threatening the sustainability of mangrove, whereas anthropogenic damage or damage caused by human activities in general have very bad consequences on the mangrove ecosystem. Most of Indonesia's mangrove forests has been damaged by illegal logging continuously by humans. Bruguiera or tancang group is the most hunted mangrove trees to be cut down because the quality of the wood is straight and hard. Then when Bruguiera has finished, Rhizophora is an option target group. Rhizophora though is not as straight as Bruguiera but has a hard wood. People use Rhizophora wood to make charcoal. Therefore both the mangrove family became the most threatened genus.

Mangrove in Indonesia is one of the richest mangrove ecosystems in the world. It consists of 59 mangrove floral and more than 50 mangrove fauna, which covers an area of 3.8 million hectares (Burbridge, 1982). Howewer, most of them are in thread. For example, the proportion of *Bruguiera spp* of mangrove ecosystem in Segara Anakan Cilacap is very worrying. *Bruguiera sexangula* and *Bruguiera parviflora* are almost extinct or highly endangered. *Rhizophora apiculata* also constantly hunted by man, while the presence of *Rhizophora mucronata* is less than 5 trees per hectare. *Avicenia alba* and *Avicenia marina* are eventually also the subject of illegal logging. Similarly *Soneratia alba* and *Soneratia caseolaris*, the latter species is known as the fruit of Sonneratia that is almost extinct. And above of all *Xylocarpus granatum* and *Xylocarpus molucensis* are also highly endangered, due to the limited number of seeds compared to other mangrove trees. On the contrary, there are several species of mangroves that have been very dominant for two decades in the Segara Anakan area. *Derris heterophylla* or in local language called gadelan grow rampant in almost all regions. This species became dominant because of the opportunity to get open space (gap) from the cutting of mangrove trees that originally covered the whole forest canopy. In addition *Acanthus illicifolius* or drujon grows quickly. This mangrove shrub is easy to grow in areas that are open and often get fresh water supply. Drujon and Gadelan grow together into a dominant shrubs and lianas in the Segara Anakan.

Nypha fruticans tree that is the only mangrove palmae family that lives today in Segara Anakan is also rampant in almost all regions. Its seeds are many and their high ability to multiply vegetatively makes *Nypha fruticans* is one dominant species in the mangrove forest area that was badly damaged by continuous logging.

Scientifically we ask: Is it possible that mangrove saplings in Segara Anakan restore itself naturally? Could mangrove trees are left at this time restore the mangrove forest structure with seeds and propagule it

generates ? Is it possible that mangrove seedlings and sapling grow well in the middle of Drujon and Gadelan dominance compete with them? Therefore, this study aims to calculate the seeds and propagules production of 13 mangrove species, and to assess the ability of the seeds and propagules to grow (recruitment) become seedlings or saplings in a span of 2-12 months.

II. METHOD

This research is a descriptive research conducted in Segara Anakan Cilacap. Data collection was done by applying purposive sampling method through field observations in March, June, August, and November 2013. Subject of this research is 10 mangrove tree species highly threatened and 3 mangrove species whose populations are relatively abundant. These mangrove species are 1) *Bruguiera gymnorhiza* (Tancang Merah), 2) *Bruiguiera parviflora* (Tancang Ngaglik), 3) *Rhizophora apiculata* (Mangrove Peanut), 4) *Rhizophora mucronata* (Mangrove Pendulum), 5) *Xylocarpus molucensis* (Nyirih), 6) *Ceriops tagal* (Tancang Aneh), 7) *Aegiceras corniculatum* (Gedangan), 8) *Soneratia alba* (Bogem), 9) *Soneratia molucensis* (Pidada), 10) Avicenia alba (Api-api), 11) *Nypha fruticans* (Nipah), 12) *Derris heterophylla* (Gadelan), and 13) *Acanthus illicifolius* (Drujon)

The sample included 5 individuals of each species. Each individual is measured tree height, stem diameter, wide canopy, number of seeds and propagules, number of seedling and sapling. Descriptive statistics were used to analyze differences in the parameters between species and over time.

III. RESULT AND DISCUSSION

Overall, the data of the observation is displayed in Table 1 at the end of this paper. This includes the production of seeds and propagules, the ability of seeds and propagules to grow become seedlings and saplings in a span of 2-12 months. In calculating the ability of seeds and propagules to be seedlings, the available data were not always appropriate to be used to portray the actual conditions. For example, the observation of *Bruguiera parviflora* in March found 8431 seeds and 3 propagules; in June found of 3423 propagules; in August discovered 2104 propagules, 5 seedling, and 16 sapling; then in November found 2310 seeds, 2 seedling, and 129 sapling. This data can be used to describe the production of seeds and propagules as well and the growth rate of the seeds and propagules to be a sapling, but cannot be used to describe the level of life (survival) of seedlings into sapling. This is apparently due to the observation time interval was too long so it did not fit with the timing of growth and development of propagules and or seedlings into sapling. Therefore, in the description and discussion of each species, understanding of recruitment is more related to the growth of seeds and propagules to be sapling.

1. *Bruguiera gymnorhiza* (Tancang Merah)

Observed mangrove tree height ranged from 3.10 - 4.85 m with a mean of stem diameter of 18.6 cm and canopy area of 6.292 m^2. In March the five tree yielding seed as much as 1983 (with an average of 396.6 per tree), which then in June has been discovered 403 propagules and 28 seedlings. On a visit in August it was found 345 propagules, 55 seedlings and 16 saplings. Observations in November found 819 seeds and 17 saplings. This mangrove species has very high ability in seeds and propagules production, and the growth of seeds and propagules to become seedlings and saplings is high also. In comparison of sapling number to the number of seeds or propagules, it may be very low with a percentage of less than 1%, but this sapling reached 33 individual, which is quite high compared to other species. Thus the ability of natural regeneration can be expected for population recovery in a relatively quick time.

2. *Bruguiera parviflora* (Tancang Ngaglik)

The tree height of observed five Tancang Ngaglik ranged from 3.39 to 5.49 m with an average of trunk diameter of 10.6 cm and the mean canopy area of 9.438 m^2. In March the five trees produced 8431seeds and 3 propagules and then the number of 3423 propagules were found in June. On a visit in August it was found 2104 propaguls, 5 seedlings and 16 saplings. Total sapling and seeds found in November reached 129 and 2310 respectively. Like Tancang merah, Tancang Ngaglik have very high production of seeds and propagules. Similarly, the ability to grow of seeds and propagules to become seedlings and saplings was very high also. The total saplings that survive were the highest compare to other species. It can be said that its natural regeneration ability is the best.

3. *Rhizophora apiculata* (Bakau Kacang)

This species had tree height ranges between 5.81 - 9:16 m with the average diameter of 18.6 cm and the mean canopy area of 14.70108 m^2. Observation in March found 11856 seeds, which then grows into 3725 propagules in June and 5376 propagules in August. *Rhizophora apiculata* have very high seed and propagules production, however, the ability to grow seeds and propagules to become seedlings can even be said to be very low to zero. In the four-times observation it was not found any seedling or sapling. Among thousands of seeds and propagules production there was none that could grow into a seedling or sapling. As a consequence, it is very difficult to expect that regeneration of this species can occur naturally in the short term without human intervention. This happens probably because environmental conditions are not suitable anymore for seedling or sapling growth. In the long-term natural regeneration can still be expected would happen when other species that have higher regeneration ability to grow and develop sapling properly so as to facilitate the growth and survival seedling or sapling of *Rhizophora apiculata.*

4. *Rhizophora mucronata* (Bakau Bandul)

Observed five Mangrove trees had diameter ranges from 13-51 cm with stem height varied between 3.89-5.53 m^2. The mean area of the canopy reached 6.1180 m^2. Survey found 595 seeds in March, and 151propagules in June, 24 seedlings in August, and 11 saplings in November. This mangrove has a capacity of seed and propagules production is much lower than mangrove of *Rhizophora apiculata*, but the ability to grow seeds and propagules into seedlings and saplings is much better. Although the number of survived sapling is not as many as of Bruguiera, its natural regeneration is good enough so that it can grow and flourish at the present condition.

5. *Xylocarpus molucensis* (Nyirih)

Mangrove Nyirih has tree height variations ranging from 3.04-6.74 m with the canopy average of 20.0860 m^2. In March and June observations found no seed, propagules, or seedling, but the later observations found 733 propagules and 15 saplings in August, 14 sapling and 117 seeds in November. *Xylocarpus molucensis* has relatively low seed and propagules production, but it has very high the ability to grow seeds and propagules into seedlings and saplings. The presence of 14 saplings at the end of observation (November) showed the ability of this species in its natural regeneration is quite successful.

6. *Ceriops tagal* (Tancang Aneh)

Tancang Aneh height was varied from 2.67–5.04 m with the average trunk diameter of 5.6 cm and a broad tree canopy of 5.6840 m^2. Observations found 1303 seeds in March, then 2308 propagules in June. It was found 1010 propagules, 12 seedling, and 29 sapling in August, and further observation in November found 69 sapling and 384 seeds. From these data it can be seen that *Ceriops tagal* has a pretty good production capacity of seeds and propagules. The ability to grow seeds and propagules to become seedlings and saplings is very good. Thus, this species can be expected to be able to recover the total population as early population before destruction. Of course this can happen only when the factors that support the destruction can be minimized or eliminated.

7. *Aegiceras corniculatum* (Gedangan)

Aegiceras corniculatum has very high seed and propagules production capacity, but it has a very low ability to grow seedlings. Produced thousands of seeds and propagules are not able to grow into a seedling. In the four-time observations it was found one sapling only. In March survey found the seeds of 2882, and then later 2415 propagules were found in June and 1215 propagules were found in August. In November observation found 6344 seeds and 1 sapling. The observed trees of Gedangan have varied height of 3.07 to 3.56 m, with trunk diameter of 11-28 cm and the average of tree canopy reaches of 9.03 m^2. Based on this data it can be said that it would be very difficult to expect the regeneration of this species can occur naturally in the short term. This happens probably because the environment condition is less suitable for the growth of seedling or sapling. In the long-term natural regeneration can still be anticipated that it would happen when other species that have higher ability to grow and develop properly its seedling and sapling are already established so it can facilitate the growth and survival of seedling and sapling of *Aegiceras corniculatum*. This regeneration need to be enhanced by human intervention in various forms, such as nurseries and replanting.

8. *Soneratia alba* (Bogem)

The spotted Bogem trees had stem diameter varies from 14 cm to 63 cm with height of between 4.75 - 7 m. Its mean canopy area was 47.37 m^2. Mangrove seed production of this species is very little compared to other species. Observations found only 108 seeds in March, 39 propagules in June, 31 propagules in August, and 9 seeds in November. These data indicate that the ability of *Soneratia alba* in seed and propagule production is relatively low, and the ability to grow seeds and propagules into seedlings is also very low. Almost a year observations has not found any seedling and sapling. This data also shows that without active conservation population of this species will continue to decline.

9. *Soneratia molucensis* (Pidada)

Mangroves of *Soneratia molucensis* have relatively better productivity than *Soneratia alba*. Five trees that were observed had tree height varied between 6.1-9.8 m and stem diameter between 14-67 cm with a mean canopy reached 30.66 m^2. On the several visits it was found 84 seeds in March, 320 propagules and 2 seedlings in June. The next observation discovered 85 propagules in August, and then 307 seeds and 11 saplings in November. Based on the results of these observations it can be said that Pidada has the sufficient ability of seeds and propagules production. Similarly, the ability to grow seeds and propagules into seedlings and saplings is very good. Its natural regeneration will be able to restore the population has been reduced due to destruction.

10. *Avicenia alba* (Api-api)

Avicenia alba that also known as Api-api have tree height varied 6.34 to 8.58 m with a mean stem diameter of 60 cm and a broad tree canopy of 42.858 m^2. Observations recognized 10736 seeds in March, then none in June and August, found 51 saplings, 16 seedlings, and 438400 seeds in November. This mangrove has very high ability in seeds and propagules production, and relatively low ability to grow seeds and propagules to become seedlings and saplings. Looking at these data it is clear that almost certainly *Avecenia alba* are able to regenerate naturally with success, the population increase will take place continuously in current condition as long as no significant interferences.

11. *Nypha fruticans* (Nipah)

Nypha fruticans also called nipah have tree height of 4.60-6.05 m with the average stem diameter of 90.6 cm and a broad tree canopy of 16.4540 m^2. It was found 498 seeds and 265 propagules in March, 178 propagules in June, 116 propagules in August, and further found 11 Sapling, 180 seedlings and 173 seeds in November. This species has relatively low capability of mangrove seeds and propagules production, but it has very high ability to grow seeds and propagules into seedlings saplings. This members of the family Palmae seems to be appropriate with the conditions of Segara Anakan Cilacap so that it can grow and develop properly. Its natural regeneration take place very quickly, especially in the month of November.

12. *Derris heterophylla* (Gadelan)

Derris heterophylla or gadelan has a height of 0.7-1.5 m with the average diameter of of 2.392 cm and the tree canopy area less than 1 m^2. Investigation discovered 24 seeds in March, 28 propagules in June, 10 propagules, 5 seedlings, and 5 saplings in August. Further study in November found 15 seeds only. This indicates that Gadelan has low capability of seed and propagules production, but relatively high ability to grow seeds and propagules to become seedlings and saplings.

13. *Acanthus illicifolius* (Drujon)

This mangrove is also known as drujon by local communities. It has plant height of 1.557-1.928 m with the average stem diameter of 1.244 cm and mean tree canopy less than 1 m^2. Seeds are known in March amounted to 1 , then in June found 10 propagules . In August found only 61 propagules , and further in November found 60 pieces of it. *Acanthus illicifolius* has relatively low capability of seed and mangrove propagules production, and the ability to grow seedlings saplings is also very low.

Based on the description per species that include seed and propagules production, the ability to grow seeds and propagules to become seedlings saplings in the span of 2- 12 months, the studied 13 species can be grouped into two, namely as follow:

The first group is the species that are capable of producing seeds and propagules which then grow into seedlings and or saplings. This group includes *Bruguiera gymnorhiza, Bruguiera parviflora, Rhizophora mucronata , Xylocarpus molucensis, Ceriops tagal, Soneratia molucensis, Avicenia alba, Nypha fruticans* that have seeds and propagules productivity and good sapling recruitment. This species are able to regenerate naturally on the current habitat conditions so that without any intervention the species will survive. It will be able to increase individuals in their habitat even though some of them may run slowly. However, this can happen only if the condition of the habitat can be maintained as it is today, or even better improved. If habitat destruction due to logging and land use conversion is still continue, the rate of natural regeneration of the mangrove trees would not be able to increase the population because the rate of cutting trees is greater. As consequences, the ability of natural regeneration will be further reduced or even disappear altogether.

The second group is the species that are capable of producing seeds and propagules but it will not to grow into seedlings and or sapling. This group includes *Rhizophora apiculata, Aegiceras corniculatum*, and *Soneratia alba*. It has good productivity in seeds and propagules, but it has a bad sapling recruitment. Species of this group seems to have lost the ability of seedling recruitment and growth of propagules or sapling in current habitat now. This occurs because environmental conditions today are no longer suitable for seedling and or sapling growth. Without human intervention this species will not be able to survive the current habitat condition, even just waiting for extinction. Moreover, if the ongoing habitat destruction continues, the extinction will be faster. In order to facilitate the regeneration of these species, some activities can be done, such as nursery to grow seedlings and propagules into a sapling in their natural habitat or elsewhere as appropriate. Then do the planting sapling that has grown in its original habitat or in places that have a certain suitable conditions to grow and thrive. To realize, the information related to this case in more detail needs to be known in advance. Therefore, research on the factors that influence recruitment or growth of seeds or propagules and seedlings or sapling becomes important and needs to be done.

Derris heterophylla and *Acanthus illicifolius* in this study demonstrated the good ability of the seeds and propagules productivity, but low sapling recruitment. These data also indicate that in fact the two species is the relatively weak competitors. Both of these species can grow and thrive in mangrove communities perhaps precisely because there are no competitors. As noted upfront (Djohan , 2007), *Derris heterophylla* and *Acanthus illicifolius* present immediately after the mangroves land were converted into shrimp ponds and then abandoned when the shrimp farms experienced bankruptcy. The absence of mangrove trees on former shrimp farm that is open appears to be the ideal conditions for the growth of both species that are often referred to as Gadelan and Drujon. If initiation of mangrove trees on this land is facilitated, for example by planting and maintaining, I am sure that sooner or later mangrove trees community will be back to earlier states. Examples of mangrove rehabilitation project on the coast of Bali, Probolinggo beach, Opak estuaries in Kretek Bantul, and Muara Angke Jakarta have proved it.

IV. CONCLUSION

Based on the description and discussion of the results, it can be concluded that the thirteenth of the studied species can be grouped into two based on the ability to produce seeds, propagules, seedling and sapling.

• Cluster of *Bruguiera gymnorhiza, Bruguiera parviflora, Rhizophora mucronata, Xylocarpus molucensis, Ceriops tagal, Soneratia molucensis, Avicennian alba,* and *Nypha fruticans* have seeds and propagules productivity and high Sapling recruitment. These species are capable of regenerating naturally on current habitat conditions so that they are able to add individual in the population even though some of them may be going slow. This can happen only if the condition of the habitat can be maintained as it is now, or even improved for the better.

• Cluster of *Rhizophora apiculata, Aegiceras corniculatum,* and *Soneratia alba* have good productivity of seeds and propagules but it has a very low sapling recruitment. These species seem to have lost the growth ability of propagules to be seedling and or sapling in their current habitat. This happens because the current environmental conditions are not suitable for seedling or sapling growth. Without human intervention most likely this species will not be able to survive, even just waiting for extinction.

Regeneration of these species should be facilitated to grow propagules into seedling and sapling, and then do replanting sapling that has grown in its natural habitat or certain places that have suitable conditions for sapling to grow and thrive.

• *Derris heterophylla* and *Acanthus illicifolius* in this study demonstrate the good ability of the productivity of seeds and propagules but have low sapling recruitment. Therefore, in order to bring back the community of mangrove trees on the land that has been dominated by the two species, it is essential to do planting mangrove trees in that land and then taking care of them until the plants are capable of producing seeds and propagules.

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Table 1. The number of seeds, propagules, seedling and sapling species generated by mangroves in Segara Anakan Cilacap March- November 2013

Species name (local)	Spesies Code	Plant height (cm)	Plant diameter (cm)	Canopy area (cm2)	March		June		August			November		
					seed	Propagule	propagule	seedling	propagule	seedling	sapling	seed	seedling	sapling
Bruguiera gymnorhiza (Tancang merah)	Bg 1	436	13	72800	176	0	16	0	0	0	0	60	0	0
	Bg 2	485	50	93600	204	0	19	0	14	20	0	8	0	0
	Bg 3	310	7	61200	105	0	22	1	31	0	0	164	0	0
	Bg 4	344	8	15000	392	0	150	14	182	1	0	343	0	0
	Bg 5	440	15	72000	1106	0	196	13	118	34	16	244	0	17
	Avrg	403	18.6	62920	396.6	0	80.6	5.6	69	11	3.2	163.8	0	3.4
	Total	2015	93	314600	1983	0	403	28	345	55	16	819	0	17
Bruguiera parviflora (Tancang ngaglik)	Bp 1	339	7	256000	337	0	81	0	92	0	0	12	0	0
	Bp 2	360	20	81000	1476	0	84	0	8	0	0	1260	0	0
	Bp 3	392	11	26000	108	3	192	0	188	0	0	640	0	0
	Bp 4	472	9	36000	2828	0	3066	0	1264	0	0	192	0	74
	Bp 5	548	6	72900	3682	0	0	0	552	5	16	206	2	55
	Avrg	422.2	10.6	94380	1686.2	0.6	684.6	0	420.8	1	3.2	462	0.4	25.8
	Total	2111	53	471900	8431	3	3423	0	2104	5	16	2310	2	129
Rhizophora apiculata (Bakau kacang)	Ra 1	916	16	110400	1496	0	469	0	448	0	0	1995	0	0
	Ra 2	846	18	241600	1432	0	1008	0	228	0	0	424	0	0
	Ra 3	581	16	654	2848	0	778	0	1100	0	0	348	0	0
	Ra 4	723	19	99900	1792	0	546	0	728	0	0	680	0	0
	Ra 5	804	25	282500	4288	0	924	0	2872	0	0	1188	0	0
	Avrg	774	18.8	147010.8	2371.2	0	745	0	1075.2	0	0	927	0	0
	Total	3870	94	735054	11856	0	3725	0	5376	0	0	4635	0	0
Rhizophora mucronata (Bakau bandul)	Rm 1	395	51	72000	52	0	25	0	423	19	0	23	0	6
	Rm 2	400	13	57600	91	0	44	0	231	0	0	9	0	0
	Rm 3	389	17	62100	53	0	15	0	259	0	0	14	0	0
	Rm 4	436	22	92700	140	0	67	0	49	3	0	19	0	5
	Rm 5	553	13	21500	259	0	0	0	337	2	0	1815	0	0
	Avrg	434.6	23.2	61180	119	0	30.2	0	259.8	4.8	0	376	0	2.2
	Total	2173	116	305900	595	0	151	0	1299	24	0	1880	0	11
Xylocarpus molucensis (Nyirih)	Xm 1	472	10	29200	0	0	0	0	0	0	0	16	0	0
	Xm 2	304	7	675000	0	0	0	0	0	0	0	0	0	0
	Xm 3	674	21	252500	0	0	0	0	733	0	15	86	0	14
	Xm 4	496	8	25200	0	0	0	0	0	0	0	10	0	0
	Xm 5	394	9	22400	0	0	0	0	0	0	0	5	0	0
	Avrg	468	11	200860	0	0	0	0	146.6	0	3	23.4	0	2.8

	Total	2340	55	1004300	0	0	0	0	733	0	15	117	0	14
Ceriops tagal (Tancang aneh)	Ct 1	417	7	63000	436	0	416	0	78	0	5	190	0	8
	Ct 2	315	6	36400	195	0	388	0	148	5	5	37	0	7
	Ct 3	331	5	82800	77	0	168	0	210	7	1	66	0	27
	Ct 4	504	5	42800	187	0	504	0	182	0	3	29	0	12
	Ct 5	260	5	59200	408	0	832	0	392	0	15	62	0	15
	Avrg	365.4	5.6	56840	260.6	0	461.6	0	202	2.4	5.8	76.8	0	13.8
	Total	1827	28	284200	1303	0	2308	0	1010	12	29	384	0	69
Aegiceras corniculatum (Gedangan)	Ac 1	356	28	101700	1170	0	714	0	180	0	0	694	0	0
	Ac 2	348	13	42400	70	0	210	0	0	0	0	1681	0	0
	Ac 3	318	11	56700	404	0	588	0	525	0	0	207	1	0
	Ac 4	307	19	74700	1071	0	903	0	330	0	0	3690	0	0
	Ac 5	311	13	176000	168	0	0	0	180	0	0	72	0	0
	Avrg	328	16.8	90300	576.6	0	483	0	243	0	0	1268.8	0.2	0
	Total	1640	84	451500	2883	0	2415	0	1215	0	0	6344	1	0
Soneratia alba (Pidada)	Sa 1	700	63	123200	38	0	0	0	2	0	0	0	0	0
	Sa 2	654	21	1984000	32	0	27	0	18	0	0	2	0	0
	Sa 3	489	33	42800	30	0	2	0	1	0	0	2	0	0
	Sa 4	475	14	158400	8	0	4	0	3	0	0	0	0	0
	Sa 5	475	20	60300	0	0	6	0	7	0	0	5	0	0
	Avrg	558.6	30.2	473740	21.6	0	7.8	0	6.2	0	0	1.8	0	0
	Total	2793	151	2368700	108	0	39	0	31	0	0	9	0	0
Soneratia molucensis (Pidada)	Sm 1	824	14	267500	0	0	37	1	6	0	0	51	0	6
	Sm 2	856	28	262500	30	0	66	0	16	0	0	93	0	1
	Sm 3	610	15	19200	0	0	33	1	17	0	0	91	0	1
	Sm 4	923	67	543600	0	0	56	0	15	0	0	52	0	3
	Sm 5	984	23	440000	54	0	128	0	31	0	0	20	0	0
	Avrg	839.4	29.4	306560	16.8	0	64	0.4	17	0	0	61.4	0	2.2
	Total	4197	147	1532800	84	0	320	2	85	0	0	307	0	11
Avicenia alba (Api-api)	Aa 1	858	46	381600	1295	0	0	0	0	0	0	45600	0	0
	Aa 2	734	33	749700	2978	0	0	0	0	0	0	116800	0	0
	Aa 3	723	66	195000	1820	0	0	0	0	0	0	77600	16	0
	Aa 4	634	69	215000	854	0	0	0	0	0	0	123200	0	22
	Aa 5	768	89	601600	3789	0	0	0	0	0	0	75200	0	29
	Avrg	743.4	60.6	428580	2147.2	0	0	0	0	0	0	87680	3.2	10.2
	Total	3717	303	2142900	10736	0	0	0	0	0	0	438400	16	51
Nypha fruticans (Nipah)	Nf 1	605	53	249900	196	149	84	0	0	0	0	66	40	4
	Nf 2	600	90	212400	27	0	0	0	0	0	0	0	132	7
	Nf 3	593	87	198000	94	98	0	0	0	0	0	0	8	0
	Nf 4	558	160	108000	102	18	0	0	116	0	0	0	0	0

	Nf 5	460	63	54400	79	0	94	0	0	0	0	107	0	0
	Avrg	563.2	90.6	164540	99.6	53	35.6	0	23.2	0	0	34.6	36	2.2
	Total	2816	453	822700	498	265	178	0	116	0	0	173	180	11
Derris heterophyla (Gadelan)	Dh 1	110	0.3	15.2	0	0	4	0	0	0	0	0	0	0
	Dh 2	120	0.47	16.9	0	0	24	0	2	2	1	0	0	0
	Dh 3	140	0.43	13.9	18	0	0	0	1	1	1	9	0	0
	Dh 4	150	0.34	11.8	3	0	0	0	2	0	0	6	0	0
	Dh 5	70	10.42	15.8	3	0	0	0	5	2	1	0	0	0
	Avrg	118	2.392	14.72	4.8	0	5.6	0	2	1	0.6	3	0	0
	Total	590	11.96	73.6	24	0	28	0	10	5	3	15	0	0
Acanthus Illicifolius (Drujon)	Ai 1	155.7	1.19	32.2	0	0	0	0	17	0	0	6	0	0
	Ai 2	192.8	0.91	20.8	0	0	0	0	5	0	0	14	0	0
	Ai 3	172.4	0.68	22	1	0	0	0	24	0	0	0	0	0
	Ai 4	190.3	2.72	0.69	0	0	10	0	10	0	0	18	0	0
	Ai 5	156.4	0.72	21.7	0	0	0	0	5	0	0	22	0	0
	Avrg	173.52	1.244	19.478	0.2	0	2	0	12.2	0	0	12	0	0
	Total	867.6	6.22	97.39	1	0	10	0	61	0	0	60	0	0

B – 08

ORGANOLEPTIC TEST OF ULTRA HIGH TEMPERATURE (UHT) MILK YOGHURT WITH THE ADDITION OF KATUK LEAVES (*Sauropus Androgynus*)

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Abstract - The purpose of this study is to determine the effect of teh addition of katuk leaves with different concentration to color, aroma, flavor, and texture yogurt produced. The basic material used is milk Ultra High Temperature (UHT) and bacteria *L. bulgaricus, S. thermophillus, L. acidophilus* and *Bifidobacterium* contained in Biokul plain yoghurt with the addition of katuk leaves in 3 concentrations formulas, ie 1 gram, 2 grams and 3 grams. Katuk leaves yoghurt of each formula were made with 3 replications, and then were compared to control (yogurt without katuk leaves addition) organolepticly by five panelists. Data then was statistically analyzed using Kruskal Wallis Test and supported by qualitative analysis. Results indicated that each formula and control showed little differences in terms of color, aroma, flavor and texture, but the differences were not statistically significant. It was therefore concluded that the addition of katuk leaves up to 3 g in 100 ml UHT milk does not affect the characteristis of produced yoghurt and still relatively the same as ordinary yoghurt.

Keyword*: yoghurt, UHT milk, katuk leaves, variation concentration, organoleptic.*

I. INTRODUCTION

One of the katuk's properties that known by public is that katuk leaves can increase the mother's milk for breastfeeding. Simple ways to intensify the mother's milk is to consume katuk leaves as fresh vegetables. Futher development, the extract of katuk leaves are made in the form of pill as medication for increasing the mother's milk (Rukmana dan Harahap, 2003).

Katuk leaves have been processed into various type of food, such as vegetable nodes, vegetable soup, sauteed katuk leaves, katuk porridge, katuk fried rice, omelet katuk leaves, katuk as fresh vegetables and tea with katuk leaves. Various processed forms of katuk leaves have made many people to consume the katuk leaves and get the benefit from it. However, it is not all consumers like katuk in processed form that already exist, so that it is necessary to find another form of processed katuk leaves that is more interesting to attract consumers. One of which is yogurt katuk leaves. Yogurt is a nutrition beverage alternative for consumers who can not consume fresh milk because of lactose intolerance, the inability to degrade the lactose that found in milk because to the lack of lactase in the digestive tract.

According Hasruddin and Pratiwi (2015) yogurt is fermented form of semi solid products produced by fermentation of milk using lactic acid bacteria. Through the chemical changes that occur during the fermentation process created a product that has the specific texture, aroma and flavor. In addition, it contains the nutritional value better than fresh milk. Traditionally, the manufacture of yoghurt starter cultures use a mixture of *Lactobacillus bulgaricus* and *Streptococcus thermophillus* with a ratio of 1: 1. Both bacteria break down the lactose (milk sugar) into lactic acid that yielded various components of aroma and flavor. Therefore, both these bacteria are known as lactic acid bacteria. *Lactobacillus* play bigger role in the formation of aroma, whereas *Streptococcus* perform larger role in the formation of taste (Surajudin, Fauzi dan Purnomo, 2005).

Rukmana (2001) explains that consuming yogurt is very beneficial for nutritional adequacy and improvement of society. Yogurt contains high nutrient with a complete nutrient, as presented in Table 1.

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Table 1. Nutritional content in Every 100 g Yoghurt

No	Nutritional content	Amount
1	Calorie	52,00 kal.
2	Protein	3,30 g
3	Fat	2,50 g
4	Carbohydrates	4,00 g
5	Calcium	120,00 mg
6	Phosphorus	90,00 mg
7	Iron	0,10 mg
8	Vitamin A	73,00 SI
9	Vitamin B1	0,05 mg
10	Water	88,00 g

Source: Rukmana 2011

Consuming yogurt can improve the health of the body, because the yogurt bacteria that enters the intestines will envelop the intestinal wall, so that the intestinal wall will be acid. In the acidic conditions microbial pathogens become depressed or unable to attack (Rukmana, 2001).

So far it has not been known the right formula to produce yogurt with the katuk leaves that will make yogurt is still aceptable. It is there fore the purpose of this study is to determine the effect of the addition of katuk leaves to color, aroma, flavor, and texture yogurt produced.

II. RESEARCH METHODS

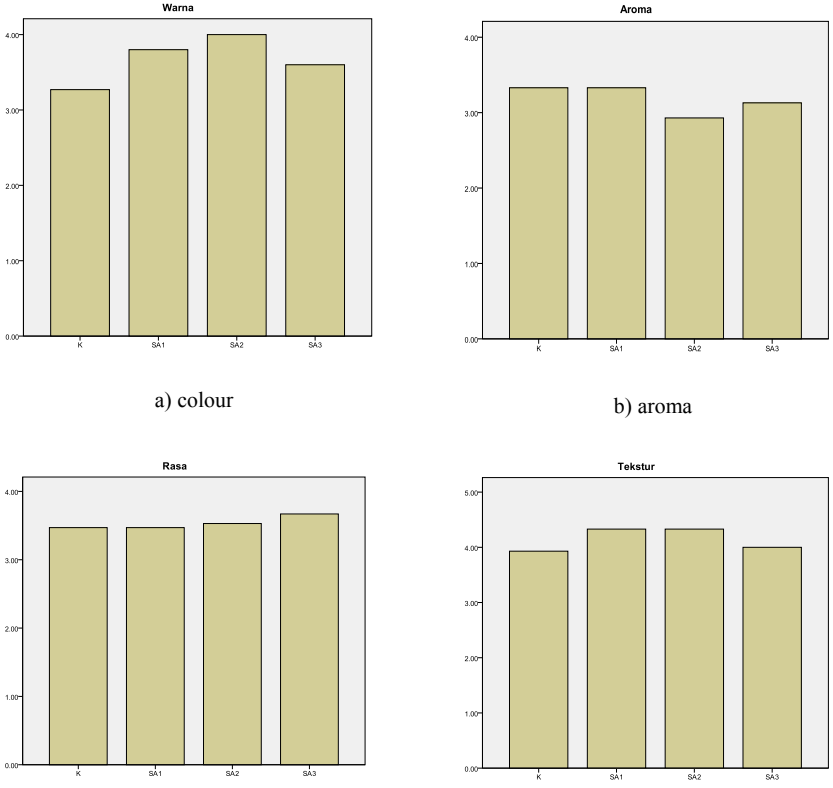
In this research yoghurt was made of Ultra High Temperature (UHT) milk with the addition of katuk leaves in three formulas, namely 1 gram, 2 grams and 3 grams. Lactic acid bacteria culture was obtaind from plain yogurt Biokul. The various concentration of katuk leaves and the use of plain yogurt Biokul were determined based on pre-study. Milk with extract of katuk leaves was fermented for 24 hours at room temperature ($\pm$ 29^{o} C).

Organoleptic tests were carried out after fermentation is stopped by means of pasteurization in accordance with the Indonesian National Standard about Yogurt number 2981: 2009. Five panelists were asked to do an organoleptic test in the senses of color (appearance), aroma (smell), taste (taste), texture (mouthfeel) and then express them in score of 1 to 5. Color test is done by means the panelists observed the katuk leaves yogurt that prepared on the glass and then the panelists gave the assessment in accordance with the scale provided on the questionnaire sheet. Aroma test conducted to introduce the properties of odor of the preparation yogurt produced to the panelists to get the value of the panelists fondness. The test involves the sense of smell, the nose. The test of taste involves the senses of taste, the tongue, and the test of texture is done in a way perceived in the mouth. The obtained data then were described and analyzed using Kruskal Wallis test with significant level of 5%, supported by qualitative analysis.

III. RESULT AND DISCUSSION

Results of the research are presented in Figure 1 and Figure 2. The first figure show katuk leaves yogurt after 24 hours fermentation, while the second figure show the results of organoleptic test including color, aroma, taste, and texture.

Figure 1. The colors of katuk leaves yogurt



a) colour

b) aroma

c) Taste

d) Texture

Figure 2. Graph of average score by panelists. K= Control, SA1= Formula 1 (katuk leaves of 1 gram), SA2= Formula 2 (katuk leaves of 2 gram), SA3= Formula 3 (katuk leaves of 3 gram)

A. Color

Color is one aspect of the organoleptic test. Direct observations demonstrate that there were differences in color among yogurt control and each katuk leaves yogurt, which can be seen in Figure 1.

Control yogurt appear white, while the treatments of SA1, SA2 and SA3 were light greens. The treatment of SA3 is greener than the treatment of SA2 and SA1 respectively. It can be said that the higher concentration of katuk leaves is added, the greener color that is produced. This green color of katuk leaves yogurt is caused by chlorophyll contained therein. Katuk leaves contain chlorophyll high enough, old leaf contain 65.8 spa d / mm, and young leaf contain 41.6 d spa / mm (Puspitasari, 2014). This study, however, did not distinguish between the old leaves and young leaves.

In figure 2a), it can be seen that the scores of yogurt color given by panelists are varied. The average color score of the treatment of SA2 (katuk leaves as much as 2 grams) was higher than the treatment of SA1, SA3 and control (no treatment). Control score is the lowest score given by panelists. The average scores of the treatment SA2 is 4 while the average scores given by the panelists for color of SA1 is 3.8 , SA3 is 3.6, and the control is 3.27. It is clear that scores of each formula of katuk leaves yogurt in term of color are different. Even so, result of the Kruskal-Wallis test indicated that all yogurt color had no difference significantly. In other words the panelist fondness on the color of the yoghurt produced is the same.

B. Aroma

Aroma is another aspect of the organoleptic test. Katuk leaves has a distinctive aroma as the smell of the leaves that not everyone likes it. Although the scent can be a quirk of katuk leaves yogurt, but the scent can also reduce the fondness of the panelists. The results of the aroma test can be seen in figure 2.b). In the graph above it can be seen that the average scores given by panelists were similar for the control and treatment of SA1 namely 3.3. The mean scores given by panelists for aroma on the treatment of SA2 and SA3 are 2.93 and 3.13 respectively. These scores showed that the addition of katuk leaves affect panelist fondness on yogurt aroma. They also noted that yogurt aroma of SA2 and SA3 was quite strong. However, result of the Kruskal-Wallis test showed that all the yogurt aroma are not different statistically.

C. Taste

Besides of the color and aroma, taste is also one important factor that affect a person's favorite food products, so that taste is also one important aspect of organoleptic test. Test results of taste can be seen in figure 2.c). The figure above shows that the scores given by the panelists to the taste of all treatment and control are not so much different. The highest average score of yogurt taste is the treatment of SA3, namely 3.67. The lowest average score is the control and treatment of SA1, namely 3.47. Treatment of SA2 has an average score of 3.53. Statistical calculations also show that there is no difference signifiantly between all treatments. In other words, fondness of the panelists to the yogurt taste all treatments are the same.

The taste of yogurt is dominated by sourness as a result of fermentation. Based on the degree of acidity, food can be classified into three groups, namely (1) food with low acidity the pH values is above 4.5; (2) foodstuffs with moderately acidic pH values range from 4.0 to 4.5; and (3) high acidic foods with a pH value below 4.0 (Kuntarso, 2007). Yogurt in this study can be classified low to moderate acidic. The sour taste is caused by the activity of lactic acid bacteria degrade lactose into lactic acid by fermentation. The formation of lactic acid from the fermentation of lactose, resulting in increased acidity of milk or milk pH decreased (Rukmana, 2001). The pH value is one of the characteristics of fermentation products.

D. Texture

The last aspect of the test is texture. Results of the texture test is presented in figure 2.d). The graph above shows that there are differences between the average scores given by the panelists to the texture of the yogurt that produced. Texture on the treatment of SA1 and SA2 had the highest average score than the others, namely 4.33. The average scores for the treatment of SA3 is 4, while the average score of the texture on the controls is 3.93. Statistical test using the Kruskal Wallis test produce significant numbers of 0.490 which is greater than the significant level of 0.05. Therefore, it can be concluded that all treatments are not proven significantly different to the fondness of panelist on the texture of yogurt produced. This is in line with the notes given by the panelists, that all yogurt texture is considered to be condensed resembling yoghurt in the market.

Texture and mouthfeel is one of the important parameters that determine fondness of consumer towards food products (Sinaga, 2007). In this study, the texture test is done in a way perceived in the mouth. All prepared yoghurt were considered to have a thick and creamy texture. This texture is determined by casein that has properties sensitive to acidity (pH). That when the pH is low milk up to ± 4.6, the casein becomes unstable and coagulated (clot) so as to form a solid (Rukmana, R., 2001).

Based on the results described above some notes need to be raised. Katuk leaves yogurt still has a distinctive odor that can decrease the panelist fondness. To that end, need to make katuk leaves yogurt with a distinctive odor that is less pungent. Katuk leaves yogurt that were prepared for the organoleptic test were plain yogurt that may reduce the panelist fondness becouse not all panelists liked the taste of sour. It should be added sweetener before testing to increase the panelist fondness on yogurt. As pH is one of the characteristics of fermentation products, so it is needed to test the pH (degree of acidity) using a pH meter, to find out exactly how sour yogurt produced.

IV. CONCLUSION

Based on the research that has been done, it can be concluded that statistically the addition of katuk leaves up to 3 g in 100 ml UHT milk does not affect the characteristis of produced yoghurt and still relatively the same as ordinary yoghurt. It does not affect the panelist fondness in terms of the color, aroma, taste and texture of yogurt produced.

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