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The effect kind of nutrients on egg (Kroto) production and egg quality of Ants (*Oecophylla smaragdina*)

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Abstract
Rangrang ants (*Oecophylla smaragdina*) are insects that produce Kroto used as bird food. The present study was conducted to determine the effect kind of nutrients on egg (Kroto) production and quality of ants (*Oecophylla smaragdina*). Sixteen colony of healthy Rangrang ants (*Oecophylla smaragdina*) were used in a completely randomized design experiment. Rangrang ants colonies were randomly divided into four treatment groups, namely: A: Rangrang ants fed with pork; B: ant given chicken eggs; C: ants given caterpillars; and D: ants given crickets, repectively. The results showed that cricket feeding gave the highest ($P< 0.05$) average yield of Kroto than the other treatments. While the quality of kroto in the treatment of pork contains the highest protein, fat, energy, phosphorus and calcium. It is concluded that cricket feeding has increased egg production, but pork feeding has the highest content of protein, fat, energy, phosphorus and calcium.

Keywords: Kinds of feed, quality, Kroto, ants *Oecophylla smaragdina*

Introduction
Rangrang ant (*Oecophylla smaragdina*) is one of the biological control agents in the world of agriculture that has several benefits. Among them, being natural enemies of pests that attack crops include cocoa, citrus, coconut, oil palm, and mango plantations. Rangrang ants are known as aggressive predators and actively hunt for prey. Rangrang ant prey is diverse, including various types of insects including green ladybugs, leaf-eating caterpillars and fruit-eating insects (Holldobler and Wilson, 1977) [10]. The rangrang ant is also referred to as a weaver ant which has a unique way of life that is knitting the leaves on a tree to make a nest (Mele and Nguyen, 2007) [15].

Rangrang ants in their colonies are very dependent on the presence of trees (Arboreal), as do other ant species. Rangrang ants have a social structure consisting of green or brown female queens, whose job is to lay eggs. The male is in charge of marrying the ant queen, and when he finishes marrying the ant queen he will die. Female workers are orange and sometimes greenish, in charge of caring for young ants produced by queen ants. Female warriors are generally orange in color, have strong long legs, long antennas and large jaws, tasked with guarding the nest from intruders, finding and gathering food for all of its colonies and building nests in trees or in leaves. Rangrang ant food in nature can be in the form of insects and liquid sugar obtained through the symbiosis of aphids that produce honey dew (Christian *et al*., 2016) [6].

In 2009 to 2011, the ant population in Indonesia decreased by 15% (Harlan, 2014) [9], this was due to the large-scale hunting of nature. Eggs, larvae and pupae are used as bird feed, fishing bait, and chicken feed because they are able to accelerate feather growth and meat production. These conditions cause the ecology in nature to be disrupted so that the population of rangrang ants in Indonesia has decreased. In Bali, every year there is an increase in the use of kroto as bird food because of its high protein content. High protein causes birds to chirp more often and stronger endurance. This is evident every time there is *kicaumania* competition of birds in Bali, the participants always increase by bringing the main feed of birds is Kroto. This also makes business opportunities for both bird and kroto breeding increasingly.

The availability of kroto in Bali comes from nature, whereas nature does not always provide Kroto according to the ever-increasing needs, moreover the rainy season of the Rangrang ant colony is definitely decreasing. The Kroto Research Institute survey results in 2010-2012 stated that market demand especially in Bali reached hundreds of kilograms per day (Kroto Research Institute, 2012) [14].

Kyoto production shortages in Bali are utilized by regions outside Bali such as Java and NTB in fulfilling markets, but the source of the roto to Kcome from nature as well, not from cultivation.

The scarcity of Kroto especially in the rainy season cannot be tolerated, Kroto cultivation is seen as a way out to meet market demand and maintain the balance of ecosystems in nature. According Kroto Research Institute (2012) [14], the quality of kroto produced from rang ant cultivation is much better, including Kroto produced cleaner, not dependent on the weather or nature, how to manage it is easier and can be predicted earlier yields and if feeding is done right on the Rang rang ants, will be able to increase the production of Kroto.

Excellence by means of rangrang ant cultivation is inseparable from the problems encountered during the process in the cage. Many factors must be fulfilled to get good quality and increased production, including the condition of the environment of the cultivation cage that must be sterile and free from pests such as chickens. In addition, the type of feed and drink must be in accordance with the needs of the ants in conducting production.

According to Prayoga (2013) [20], feed is a very important component as a source of nutrition for rangrang ants to produce. The main nutrient needed by rangrang ants is the same as other livestock, namely protein and carbohydrates (sugar). Protein is one of the nutrients that are needed by ants, especially for the purpose of production, because this protein after being metabolized in the body, digested and absorbed, it will get the final result which is the production (output) from livestock. The role of protein is very important in the body of livestock, not only as a determinant of the quality of production, but also for basic living needs and activities. Protein requirements are adjusted to the ability of livestock to consume protein and consider the balance of food substances because it affects the speed of growth (Ratri *et al*., 2017) [21].

Given the increasing need for kroto cultivation is important, but so far there have been no studies that show maximum results. The main factor influencing is the existence of rangrang ant populations in each region. In the Waters area of Yogyakarta, the rangrang ant population is abundant because it is supported by natural factors that are able to meet the needs of Kroto in several regions in Indonesia such as Java and Jakarta. In contrast to other regions such as Bali and NTB which are not so much supported by nature but Kroto's needs continue to increase.

The existence of rangrang ant populations in Bali is still not widely cultivated. The results of preliminary research rangrang ant population is very abundant found in the mango trees belonging to residents in the estate or housing. The larger size of the colony in the mango tree, compared to jackfruit, guava and avocado trees, can be utilized by residents by giving the rest of the pork consumed by residents by putting it on the tree trunk, so that the population of rangrang ants in the tree continues to increase and the resulting Kroto can be utilized with economic value. In addition, preliminary results also indicate that the cultivation of feeding affects the production results. By testing the feeding of crickets (*Gryllus bimaculatus*), hongkong caterpillars (*Tenebrio molitor*) and egg whites the ants' aggressive level of looking for feed is higher than the feeding of fish and grasshoppers, besides the resulting Kroto is also larger in size. Similar to the administration of a sugar solution, if it is too tasteless, the ant's aggressive level is also low and the population rapidly declines. With the right size combination, and using transparent plastic bottles as a colony in cultivation, we can know when the right time to harvest. Therefore, this study aimed to evaluate the effect of kind of nutrients on egg (Kroto) production and quality of ants (*Oecophylla smaragdina*).

Materials and Methods

Animal treatments and experimental design: Sixteen colony of healthy Rangrang ants (*Oecophylla smaragdina*) were used in a completely randomized design experiment. Rangrang ants colonies were randomly divided into four treatment groups, namely: A: Rangrang ants fed with pork; B: ant given chicken eggs; C: ants given caterpillars; and D: ants given crickets, repectively. The four treatment feeds were given in one piece and ants have free access to feed and water during the experiment. Each treatment was repeated four times in plastic bottles containing about 1000 ants and 50 queen ants. The plastic bottles used are bottles with a capacity of 1 liter. More detailed is presented in Figure 1.

Fig 1: Plastic bottles for ant treatment

Testing the feed and quality of kroto

Tests of nutrient content (protein, fat, energy, sugar and Ca and P minerals) in feed samples (crickets, caterpillars, chicken eggs and pork) and kroto quality were conducted at the Laboratory of the Faculty of Agricultural Technology, Udayana University. Eggs samples and feeds were carried out in an appropriate analysis to determine dry matter (DM) and organic matter (OM), respectively. Dry matter (DM) and organic matter (OM), and ash determination were carried out in accordance with the Official Analytical Chemistry Association (2005) [2]. All tests are carried out in triplicate.

The search for Rangrang ant (*Oecophylla smaragdina*) colonies

The search for rangrang ant colonies was obtained from a 30-40 cm diameter mango tree and only one queen ant queen was selected. Preliminary research results show that colonies sourced from mango trees produce kroto faster than jackfruit, guava and avocado trees.

Egg (Kroto) production calculation

Kroto counting or harvesting is done 3 times (up to the lowest population). The first is done 15 days after feeding, the second is done on the 30th day, and the third is on the 45th day. The yield of each harvest is Kroto clean by calculating the weight of the child, the number of children, and the overall weight.

Data analysis

Research data were analyzed by analysis of variance. If there are significantly different results ($P< 0.05$), it is followed by Duncan's multiple range test at the 5% level (Astawa, 2017) [3].

Results and Discussion

Composition of Kroto test results before being fed or sourced from nature as a control have almost the same content, although there are numerical differences. This is because the available food sources depend on nature, Anato *et al*. (2017) [1]. Stated in 1 tree, the quality content of Kroto is almost the same. This is due to available food sources such as honey dew sourced from aphids have a symbiosis of rangrang ants. In addition to do, various insects become a source of food for rangrang ants in trees that follow seasonally, it causes the content in kroto to be the same (Nugroho, 2013) [18].

Table 1: Nutrient composition of eggs (Kroto) before treatments

Sample code	Water (%)	Ash (%)	Protein (%)	Fat (%)	Calories (Kal)	Phosphorus (mg/Kg)	Calcium (mg/Kg)	Sugar %
Control 1	80.02	0.82	10.49	3.57	94.487	1236.13	49.302	5.30
Control 2	79.30	0.58	10.17	4.08	100.897	1122.55	71.749	5.91
Control 3	79.71	0.82	10.23	3.54	95.595	1467.22	71.437	8.12
Control 4	79.66	0.85	10.31	3.66	96.271	1225.26	110.720	8.36

While the test results of pork feed contain the highest protein, fat, energy, calcium and phosphorus except sugar. Ccaterpillars have the highest sugar content (7.08%) while crickets, egg whites and pork have almost the same sugar content (0.45%; 0.25%; 0.12%). By providing different feeds, different production values are produced. Prasetyo *et al*. (2015) [19]. Giving a single type of grasshopper feed is able to produce a high kroto production value especially if combined with hongkong caterpillars will produce the highest value compared to other treatments. Feed affects the quality and production of kroto produced during certain seasons and environments (Moses *et al*., 2015) [16].

Table 2: Nutrient composition of pork, chicken eggs, caterpillars and criket

Kinds of feed	Water (%)	Ash (%)	Protein (%)	Fat (%)	Calories (Kal)	Phosphorus (mg/Kg)	Calcium (mg/kg)	Sugar %
Pork	52.75	3.98	17.56	22.04	283.309	7573.990	1787.770	0.12
Chickens eggs	84.39	0.55	12.50	0.36	62.027	201.550	44.004	0.25
Caterpillars	61.83	1.39	0.45	12.83	211.287	2393.910	82.729	7.08
Cricket	72.07	1.19	0.38	7.30	143.489	1827.860	116.650	0.45

Egg (Kroto) Production

Cricket feeding gave the highest average production of kroto which is 116.4 grams compared with 107.5 grams of caterpillars, 101.55 grams of pork and 101.15 grams of chicken's eggs. The results of statistical analysis show that the different feeding did not have a real effect but on average there were differences in the production of kroto produced. Feeding crickets from the initial harvest produced the highest production, while feeding the first caterpillar was higher than pork and chickens eggs, while the second crop produced the lowest caterpillar.

The high production of kroto produced by ants (*Oecophylla smaragdina*) in cricket feeding is due to the type of feed that is easily transported into the nest. The existence of feed in the nest makes the supply of food to the Queen available to produce kroto optimally. According to Vikas Nagar and Lucknow (2012) [23]. The type of insect feeding is preferred by rangrang ants so that it is easier to transport in cooperation, compared to large feeds such as fish carcasses only preferred when the feed is still fresh. The same thing was added by Fadia (2013) [7]. Feeding outside large nests such as meat makes cannibalism in the nest so that the population of worker ants decreases causing food suppliers to decrease.

Table 3: The effect kind of feeds (pork, chicken eggs, caterpillars and criket) on egg production of ants (*Oecophylla smaragdina*)

Eggs/Kroto Production	Kinds of feed			
	Pork	Chicken eggs	Ccaterpillars	Cricket
Harvest I (g/colony)	105.4	105.9	122.8	132
Harvest II (g/colony)	97.7	96.4	92.2	100.7
Total (g/colony)	203.1	202.3	215.0	232.7
Average weight (g/colony)	101.6	101.2	107.5	116.4

Fig 2: Ant Queen (left) and egg/Kroto (right)

he content in the feed affects the amount of production produced, but by way of cultivation is only able to produce sustainable kroto not optimally. Frances (2016)[8] research results showed that the production of kroto from rangrang ants culturally in a cage was lower than the cultivation in nature by giving feed that was hung in the trees. In nature, every 1 colony with a diameter of 30 cm can produce 46 grams of kroto. This is due to the types of animals that live in colonies when moved with modern nests, production will decrease but be sustainable. This theory is supported by Jolivet (1996) [12]. who cultivated bee (*Trigona sp.*) in a

modern way that the production obtained was 37% lower and the time required was longer than cultivation in nature, this is due to not all types of animals that live capable of colonizing are able adapt well to modern nests. The low production of kroto obtained in the treatment of pork (203.1 grams) and chickens eggs (202.3 grams) is due to faster rot food which is avoided by rangrang ants. Always the availability of feed with a change of 3 days once unable to suppress spoilage. According to Christian *et al*. (2016) [16]. The cultivation of rangrang ants that must be prioritized is the cage in a sterile state, the absence of pungent odors, the absence of vibrations, and the absence of noise. This is very disturbing situation in the colony that caused cannibalism. Joachim *et al*. (2012) [11]. Pork is only able to survive 24 hours in an open space before decay, but it is very useful in cultivation in nature to maintain the ant population in each tree. In the rangrang ant cocoa cultivation used as a natural enemy, in Bali one way to maintain the rangrang ant population in the cacao tree is by feeding it in the form of pork or chicken.

The second harvest in the treatment of caterpillars gets the lowest yield of the others (92.2 g), this is because the rangrang ants only form 1 colony out of 4 replications with a final harvest population of 65.7%. External factors greatly influence the formation of nests or colonies, including wind, and noise, predators such as lizards and geckos. The average noise level is measured at 40 dB because the location of the nest in a closed room is more sterile.

Egg (Kroto) Quality

There were differences in the quality of eggs (Kroto) produced after being treated. The Kroto pork treatment produced has the highest protein, fat, energy, phosphorus and calcium content except sugar. This is because between treatments, pork has the highest content of protein, fat, energy, phosphorus and calcium which also affects the quality of the kroto produced. Christian *et al*. (2015)[5] in their research results, the highest content produced from the treatment given did not affect the amount of production, in this study, pork has the highest content except sugar, but the highest amount of Kroto production in cricket treatment. Kroto is used as a bird feed because it is able to maintain endurance, and birds chew quickly, especially given during the growth period of birds (Nanna *et al*., 2016) [17]. The results of Thora *et al*. (2015) [22]. Giving Kroto from half the Kroto cultivation obtained from nature as bird food, this is due to the nutritional content such as protein in kroto cultivated higher than Kroto from nature. In addition to being more efficient, cultivated Kroto can accelerate the growth of bird feathers and is shinier.

Table 4: The effect kind of feeds (Pork, chicken eggs, caterpillars and criket) on egg quality of ants (*Oecophylla smaragdina*)

Sample	Water (%)	Ash (%)	Protein (%)	Fat (%)	Calories (Kal)	Phosphorus (mg/Kg)	Calcium (mg/Kg)	Sugar %
Pork 1	65.72	2.88	14.37	14.13	196.27	4405.06	918.536	5.53
Pork 2	67.69	3.66	14.12	13.51	182.15	4225.16	919.440	6.20
Pork 3	66.46	2.40	14.68	13.48	191.98	4351.56	918.650	6.42
Pork 4	67.85	2.47	14.07	13.24	184.94	4324.23	917.540	6.74
Chicken eggs 1	80.75	0.54	11.64	2.84	89.06	662.05	57.877	4.74
Chicken eggs 2	79.34	0.59	10.96	3.14	95.98	665.53	57.210	3.78
Chicken eggs 3	80.54	0.54	11.61	2.57	88.55	654.52	57.350	4.32
Chicken eggs 4	80.54	0.57	11.48	2.56	88.36	653.12	57.640	3.69
Caterpillars 1	70.40	1.10	5.69	6.68	147.40	1930.57	77.083	7.58
Caterpillars 2	70.27	1.19	5.25	6.67	147.53	1935.34	77.230	8.10
Caterpillars 3	71.73	1.12	5.5057	5.65	136.8380	1928.56	76.850	8.89
Caterpillars 4	71.64	1.11	5.04	6.01	139.06	1930.88	77.54	7.84
Cricket 1	76.24	1.01	5.18	4.15	111.75	1526.56	113.69	4.36
Cricket 2	75.04	1.16	5.22	4.94	119.92	1557.56	114.81	4.32
Cricket 3	74.85	1.08	5.07	4.57	119.10	1547.25	113.54	5.24
Cricket 4	74.96	1.06	5.32	4.99	120.83	1498.68	112.56	4.85

Different feeding also influences the number of queen candidates produced. The emergence of a potential queen plays an important role in forming a new colony later as Kroto production. The feeding of caterpillars produced a 75% queen candidate in the first harvest and 50% in the second harvest compared to other treatments ranging from 15%. This might be due to the high sugar content in the caterpillar affecting the production of rang rang ants to produce a queen candidate. Aswathi *et al*. (2012) [4]. Also mentioned that the emergence of queen candidates is influenced by the season, in the dry season the rangrang ants produce dominant queen candidates aiming for the rainy season the population still persists with the number of queen candidates who produce generations later. The same thing was also stated by Kadambari (2016) [13]. During the rainy season, the rangrang ant population declined because the knitted nests in the trees were disturbed so that the production of Kroto was reduced. But during the dry season it is used to breed as much as possible especially to produce prospective queens. By way of cultivating disturbances from environmental factors can be suppressed to produce Kroto maximally.

Conclusion

We conclude that the kind of feeds, namely crickets, caterpillars, chicken eggs and pork affect the egg (Kroto) production of ants (*Oecophylla smaragdina*). The highest productivity in cricket feeding, while the lowest in chicken egg feeding. The treatment feed of pork produced has the highest content of protein, fat, energy, phosphorus and calcium.

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