The Formulation of *Apis mellifera* L. Honeybees Feed Making as Pollen Substitute on Poor Season

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Abstract. The *Apis mellifera* honey bees is one of the most cultured species in Indonesia, both by ordinary people, government (Perum Perhutani and Forest Service) as well as private companies that are managed in a modern way. This research aims to find out the best artificial feed formulation for *Apis mellifera* hone bees. This research used randomized block design with 4 treatments and 3 replications. The treatment is as follows: Treatment A: Soybean flour + sugar syrup, Treatment B: Dried peanut flour + sugar syrup, C: Peanut flour + sugar syrup, Controls: Natural pollen in flour form. The data obtained were analyzed by Randomized Block Design Equation.

The results showed that the type of pollen substitute TKH and natural pollen is the best feed to increase the growth of *Apis mellifera* L. bee seedlings in terms of the increase of consumption level and the extent of saplings.

1. Introduction

*Apis mellifera* Bee L is one of the most cultivated species in Indonesia, both by ordinary people, the government (Perum Perhutani and the Forestry Service) and private companies that are managed in a modern way. *A.mellifera* bees are the main types of bees that are cultivated in almost all countries, these bees are widely found in Europe [1]. Its ability to produce honey is very high, making many bees introduced to new areas that were previously the deployment of *Apis cerana*. *A. mellifera* bee is a honey bee from Italy, but this type of honey bee can adapt well to be developed in Indonesia.

Bee *A. mellifera* is a honey bee that has high productivity and is easy to adapt to climate in Indonesia [2]. In addition, the specialty of this bee is that it is benign, so it is easily cultivated by the community. Beekeeping can also provide indirect benefits, namely relating to the preservation of forest resources, increasing productivity of crops through mutual symbiosis between plants and honey bees because in the process of finding honey bee food will help the process of pollinating flower plants [3].

Nectar, extranutfialnectar and pollen are foods needed by honey bees for the survival of bees. Nectar is a liquid in plants that is secreted by plants through the nectar gland, which varies in various parts of the plant, nectar is divided into two types, namely floral and extrafloral. Plants that are a source of nectar include Kapuk Randu flowers (*Ceiba petandra*), Lengkeng (*Nephelium longanum*), Durian (*Durio zibethinus*), Sengon (*Arachis hypogea*) and others. While pollen is a fine material such as powder found on the end of the flower stamen which is a male sex in plants and a source of protein. Honey bees need 20% protein in their food to meet their daily needs [4]. Plants that are the source of pollen include cori (*Zea mays*), Lamtoro (*Leucaena sp*), Coconut (*Cocos nucifera*), Kapuk Randu (*Ceiba petandra*) and others [1].

The availability of feed in nature is one of the determining factors for the success of honey bee cultivation. Nectar and pollen provide carbohydrates, proteins, fats, vitamins and minerals needed by honey bees for the development of their colonies. Most of the energy needed by honeybees comes...
from nectar, while more protein content is found in pollen needed for larval growth, development of hypopharyngeal glands and body fat [5]. Besides nectar and pollen bees also need.

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Sidrap Regency is a fairly large corn producing area during the rainy season which is the main source of pollen for honey bee cultivation. Empty land is planted by the community to fulfill poultry feed in Sidrap Regency as the largest egg producer in Eastern Indonesia. But at the end of the rainy season, the availability of pollen is very limited, along with the end of the maize season, so beekeepers need artificial bee feed for the survival of bees farmed.

Limited availability of pollen or non-flowering plants that provide pollen in nature (famine), usually beekeepers overcome by providing pollen substitute feed (Pollen Substitute) made of materials with high protein content. The problem of pollen availability also arises when farmers farm honeybee colonies in areas that provide a lot of nectar-source plants, but there is no plant source of pollen or pollen, therefore alternative materials are needed to overcome these problems. Some types of nuts have been known to have good nutrients and the percentage of protein is quite high, including soybeans, green beans and peanuts.

2. Research Methods

2.1 Location and Time

This research was conducted in March 2017 in Bulo Village, Panca Rijang District, Sidrap Regency, South Sulawesi Province.

2.2 Materials and tools

The equipment used in this study was transparent plastic, digital scale capacity of 1 gram, millimeter paper, scissors, label paper, brushes and stationery. While the materials used in this study were soybeans, green beans, peanuts, natural pollen, sugar and 12 colonies of Apis mellifera bee.

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2.3 Research design

In this study a randomized block design (RBD) was used with 4 treatments and 3 replications. The treatments as follows:

a. Treatment A: Soybean flour + sugar syrup
b. Treatment B: Green bean flour + sugar syrup
c. Treatment C: Peanut flour + sugar syrup

d. Control: Natural pollen in the form of flour

### 2.4 Variable Observed

The variables observed in this study were:

- (a) Replacement feed consumption before and after treatment (gram / week / colony)
- (b) Area of tillers before and after treatment (cm² / week / colony), after treatment.

### 2.5 Data analysis

The data obtained will be analyzed by group randomized design analysis (RBD) as follows [4]:

\[
\begin{align*}
\text{Yes } i & = 1, 2, \ldots, t \\
\text{J } & = 1, 2, \ldots, r_i \\
\text{Information:} \\
Y_{ij} & = \text{Observation value from the first treatment in the } j \text{th group} \\
u & = \text{Middle population value} \\
i & = \text{Additive effect from the } i \text{ treatment} \\
j & = \text{Additive effect from } j \text{-group} \\
ij & = \text{Effect of experimental error from the first treatment in the } j \text{-group} \\
j & = \text{test} \\
i & = \text{treatment} \\
\text{If the data obtained, the treatment has a significant effect on the observed variables, will be followed by the} \\
\text{Tukey follow-up test.}
\end{align*}
\]

### 3. Result and Discussion

#### 3.1 Consumption of Substitute Pollen

Consumption of substitute pollen in colonies that receive various substitute pollen flour has an average range of 29.67-98.67 grams / colony / week. The results of the variance analysis in Appendix 4 show that substitute pollen flour given is significantly different from the consumption of substitute pollen. This might be due to the content of the nutritional value of the feed given is sufficient. According to its function, substitute pollen must fulfill several conditions, namely to attract the attention of honey bees so that honey bees want to eat substitute pollen provided, substitute pollen-making materials are always available in large quantities and cheap, the cost of making replacement pollen is not too large, the nutritional value of the honey fulfills the nutritional needs of honeybees, and does not contain toxic components for bees [12].

The results of the follow-up / Tukey test can be seen in Table 6 as follows:

| Treatments   | Average consumption of substitute pollen (grams) | Tukey 0.05 |
|--------------|--------------------------------------------------|------------|
| TKK          | 57.00                                            | a          |
| TKH          | 94.67                                            | b          |
| TKT          | 29.67                                            | a          |
| POLEN ALAMI  | 98.67                                            | b          |

The results of Tukey’s further test in Table 1 show that the type of pollen substitute for TKH with an average value of consumption of 97.67 grams / colony / week is the best. The table above also shows that the replacement pollen for TKH with a value of 94.67 grams / colony / week was not significantly different from natural pollen, which was used as a control with a value of 98.67 grams / colony / week. Whereas, for substitute polls for TKK and TKT differ significantly with an average value of 57.00 and 29.67 grams / colony / week against natural pollen with a value of 98.67 grams / colony / week which is used as a control. So it can be concluded that, the type of TKH replacement pollen can replace natural pollen. This is in line with estimates of pollen consumption in worker bees are as much as 3.4 - 4.3 mg per day per head [2]. Feed in the form of pollen is very important for newborn bees, besides pollen also functions to build body fat, the development of the night and ovary glands and extend the life of the bee [2].
The following diagram shows the average consumption of substitute pollen given to bee A. mellifera for one week as follows:

Table 2. Tukey test results Consumption of substitute pollen.

| Treatments | Average consumption of substitute pollen (grams) | Tukey 0.05 |
|------------|-------------------------------------------------|------------|
| TKK        | 57.00                                           | A          |
| TKH        | 94.67                                           | B          |
| TKT        | 29.67                                           | A          |
| POLEN ALAMI| 98.67                                           | B          |

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The following diagram shows the average consumption of substitute pollen given to bee A. Mellifera for one week as follows.
Based on Figure 1, in the variable consumption of substitute pollen, the lowest consumption of colonies is a colony that receives TKK and TKT (57 and 29.67 grams / week / colony) while the highest consumption is in colonies that receive natural pollen feed and TKH (98.67 and 94.67 grams). The number of substitute pollen consumed by bees tends to be different as seen in Figure 1.

Different consumption of substitute pollen given is thought to be influenced by the texture and aroma of each substitute pollen given. TKT has a slightly sticky and oily texture while TKK has a bad odor and is also a little oily, the texture of TKH is more dense when compared to TKT and TKK. The aroma of artificial pollen TKH has a distinctive aroma of green beans.

The sense of smell in bees was very sharp to find out the aroma of the food he liked with 30,000 odor receptors on the antennae [3]. The most determining factor of pollen (feed) is smell [7].

The low consumption of TKK is also supported by the results of research which provides artificial pollen feed treatment using soybean based ingredients in the form of pasta [6].

### 3.2 Area of Tiller Cells

The extent of tillering cells in colonies that receive various types of replacement pollen, has an average range of 21.56-48.45 cm² / colony / week. The results of the measurement of the width of bee saplings can be seen in appendix 2. From the data analysis variance in Appendix 4, the replacement pollen given is not significantly different from the total number of tillers cells formed. It is assumed that the nutrient content consumed is not enough. Pollen serves for the development of feeding glands for nurse bees that emit compounds called royal jelly with high protein content and are a food for newly hatched larvae and food for queen bees [8 in 9].

The following is a diagram of the results of the average cell size of tillers as follows:

![Figure 1. Average consumption diagram replacement pollen](image1)

**Figure 1.** Average consumption diagram replacement pollen

![Figure 2. Diagram of the average cell size of tillers](image2)

**Figure 2.** Diagram of the average cell size of tillers
Based on the image 2, the lowest area of tillering cells is the colony that gets TKK and TKT (21.56 and 21.92 cm² / week / colony) while the highest cell size of the tillers is in the colonies that get NATURAL POLEN and TKH (48.45 and 45.01 cm² / week / colony).

The difference in the extent of tillering cells in the colonies which received various types of pollen substitute flour was suspected, because of the amount of pollen substitute flour consumed. The quantity and quality of pollen in the nest will affect the number of tillers, especially the number of eggs [8].

The large number of bee populations and the extent of tillers in honeybee colonies are also influenced by several factors such as temperature, climate, geographical location, and age of the queen [10]. The factors that cannot be controlled in this study are the fertility of queen bees in laying eggs.

### 3.3 Area of Cells Containing Pollen

The area of pollen-containing cells in the colonies which received various types of pollen pollen substitutes flour, ranged from an average of 31.63 to 81.90 cm² / colony / week. The results of measurement of cell area containing pollen during the study can be seen in appendix 3. From the variance analysis data based on appendix 4. Flour substitute pollen given is significantly different from the cell area containing pollen. Based on statistical tests, treatments that were significantly different could be tested further by the Tukey test. This can be seen in table 7 below:

| Treatments   | Average cell area containing pollen (cm²) | Tukey 0.05 |
|--------------|------------------------------------------|------------|
| TKK          | 40.84                                    | a          |
| TKH          | 65.46                                    | b          |
| TKT          | 31.63                                    | a          |
| POLEN ALAMI  | 81.90                                    | b          |

Tukey's advanced test results (Table 3) show the types of pollen substitutes for NATURAL TKH and POLEN provide the best effect on the number of cell areas containing pollen with values (65.46 and 81.90 cm² / colony / week) compared to substitute polls for TKK and TKT with values (40.84 and 31.63 cm² / colony / week).

![Table 3. Tukey test results for cell width containing pollen](image)

Based on (Figure 3.) showing the lowest pollen cell area is a colony that receives replacement pollen type TKK and TKT with the cell area formed 40.84 and 31.63 cm² / week / colony, while the highest is in the colony got a replacement pollen type of TKH and NATURAL POLEN with the cell area formed 65.46 and 81.90 cm² / week / colony. The intensity of worker bees in collecting pollen only reaches the level of fulfilment [8]. In addition, the number of pollen collected will correlate with the number of daughter cells.
formed or the rate of laying queen bees. This is in line with the number of tillers and the cell area containing pollen formed in this study.

4. Conclusion
Based on the results of the research conducted, it can be concluded that the type of pollen substitute for TKH and natural pollen is the best feed for increasing the growth of Apis mellifera L. bee in terms of increased consumption levels and broad tillers.

5. Suggestion
Apis mellifera, It should be extended past. Respond to flour of various types, possibly only after a few weeks. And avoid using basic language that uses oil.

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