Drying Methods Effect on Chemical Content of Pollen, Study of Oil Palm Pollen as Honeybee Feed

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ABSTRACT
Oil palm (*Elaeis guineensis* Jacq.) is a plant that is used as raw material for various food products, medicines, cosmetics and energy sources. Oil palm has a productive age of up to 25-26 years, harvested from the age of 3-4 years, and reaches peak production at the age of 9-14 years. As a fruit-producing plant, oil palm produces compound flowers in the form of a tuft and increases in number with age, thus providing the potential for pollinating insects such as bees to obtain pollen as a protein source for their colonies. The purpose of this study was to determine the difference between sun dried pollen and oven-dried pollen on chemical contents as honeybee feed. The research used two pollen drying methods with sun drying and oven drying at 60°C in 4 hours and analyzed with a completely randomized design (CRD) method with 6 treatments and 4 replications. The result showed that the drying method gave some different effects ($P<0.01$) on proteins, fat, and ash contents, so it can be concluded that the drying method had some effect on nutrient content. The conclusion of this study is the oven drying method had lower water contents that prevent the pollen from easily rotten and had higher proteins, fat, and carbohydrate contents that are beneficial for honeybee colonies.

Keywords: *pollen, palm oil, sun drying, oven drying, chemical content*

1. INTRODUCTION

Indonesia has sufficient natural resources, both from livestock to plantations. Palm oil is the largest plantation commodity in Indonesia which has experienced rapid growth and development, especially in the last two decades. The area of oil palm plantations in Indonesia reaches 14,858.30 hectares spread throughout Indonesia [1] with a total production of 49,710,345 tons [2]. This type of palm tree is the largest producer of vegetable oil in the world which comes from fruit fibers and kernels that can be produced properly. In addition to oil, other products produced by oil palm trees are very diverse. As quoted in the Ministry of Trade [3] that palm oil can provide benefits in the manufacture of cooking oil, margarine, soap, cosmetics, steel industry, wire, radio, leather and pharmaceutical industries.

Honey bee cultivation is growing along with the times, considering that the products produced by honey bees have high economic benefits and value. To maintain their life, honey bees need sufficient food in the form of nectar and pollen. Pollen which is pollen from flowering plants and is usually used as a source of protein also has other content including carbohydrates, fatty acids, antioxidants, as well as vitamins and minerals. The formation of pollen is done with a mixture of pollen, honey, nectar to the fluid in the bee's body.

Generally, all flowering plants are a source of food for bees because flowers are pollen producers. Adequate feed supply can increase honey bee production. The occurrence of alternating and prolonged dry and rainy seasons causes the flowering cycle of flower plants to be disrupted which can result in insufficient natural food for honey bees [3]. Oil palm pollen is pollen produced from oil palm flowers and can be used as feed for bees. This pollen can be a natural food source for honey bees whose availability can be maintained because oil palm plants have fairly high production and are spread throughout Indonesia, although the content of oil palm pollen has not been identified with certainty.

2. MATERIALS AND METHODS

The research location was carried out at the Faculty of Animal Husbandry, Universitas Brawijaya, Malang with the research period being carried out on September 14, 2021 - November 4, 2021. The material used in the research pilot was bee pollen obtained from BUMD partners Karya Kencana Jambi. Pollen samples that had been dried for 12 hours were then divided into 2 drying treatments, namely without further drying as a control treatment (P0), and with further drying, treatment using an oven at a temperature of 60°C for 4 hours (P1).

P0 = sun-dried pollen

P1 = sun+oven-dried pollen

Each treatment was put into 100g plastic clips and analyzed through the Laboratory of Food Quality and Safety Testing, Faculty of Agricultural Technology, Brawijaya University, Malang and the Central Laboratory of Food and Nutrition Studies, Gadjah Mada University.

The variables observed in this study include: Protein content measured by the method according to the *Association of Official Analytical Chemist* (AOAC). Fat content according to the *Association of Official Analytical Chemist* (AOAC). Moisture content measured by oven drying method. Ash content as measured by the furnace method. Carbohydrates are measured according to the method according to the *Association of Official Analytical Chemist* (AOAC). Dissolved protein levels were measured by the Lowry method using a spectrophotometer.

3. RESULTS AND DISCUSSION

3.1. Protein

Based on the results of the analysis in Table 1, there was a very significant difference in the protein content in pollen ($P<0.01$). The results of laboratory analysis showed that the highest protein mean was obtained from treatment P1 which was a treatment by drying using an oven. This shows that in the oven the pollen still has higher protein content. Protein has a characteristic that is easily damaged by heat treatment, but with the right drying method the protein in the pollen is not easily damaged; besides drying can kill microorganisms and extend the shelf life of pollen. Based on this, pollen with oven drying has a better quality to be used as bee feed.

Bee pollen is consumed as a source of protein by bees. The amount of crude protein in the average pollen is 23% and contains a variety of essential amino acids to essential fatty acids. Jaya [4] stated that the crude protein content in food and feed below 20% was categorized as a feed with poor quality and unable to meet the nutritional content needed by bees. Crude protein content ranging from 20-25% is classified as feed with standard or average quality, while for the good quality it has a crude protein level above 25%.

3.2. Fat

The results of the analysis of variance of the content showed that the drying treatment had no difference in the fat content of the pollen.

Pollen-producing plants can produce varying levels of fat in pollen. According to Huang [5] in pollen there are quite a lot of lipids and sterols that are used as temporary energy storage for the insect body. The average fat content in pollen is usually less than 10% [6]. Unlike protein and carbohydrates, honey bees require relatively low amounts of fat [3]. Fat content consists of saturated and unsaturated fats. As much as 70% of the total, average unsaturated fatty acids are found in pollen, with 19-56% consisting of oleic, linoleic, *araquidic* to palmitic acids of the total unsaturated fatty acids present [4].

3.3. Water content

The results of the analysis of the various pollen moisture content showed a very significant difference ($P<0.01$) and a significant effect of the drying treatment on the pollen moisture content. The moisture content of pollen with sun drying is higher than oven drying, this is because oven drying is a controlled drying method while sun drying depends on several factors, especially weather factors. High water content has the potential to cause pollen to be easily damaged because the higher the water content in a material, the growth of

Table 1. Results of Analysis of Pollen Chemical Content

Treatment	Protein	Fat	Water content	Ash	Carbohydrate	Dissolved Protein
P0	17.89±0.042 [a]	0.75±0.037 [a]	19.53±0.038 [a]	3.25±0.039 [a]	58.58±0.024 [a]	2.70±0.012 [a]
P1	18.83±0.022 [b]	0.81±0.016 [a]	16.88±0.04 [b]	3.55±0.029 [b]	59.93±0.038 [b]	2.67±0.015 [b]

Superscript [a] and [b] show a significant difference in data between P0 (sun drying) and P1 (sun+oven drying) treatments

microorganisms in the material is easier to develop. This shows that oven drying can reduce the moisture content significantly.

The water content can affect the shape, texture and taste. The water content contained in pollen with different plants has different amounts and is supported by the time of pollen collection. The time of pollen collection can cause an influence on the moisture content by evaporation of water in the pollen when it is taken during the day [7]. The bee colony needs water as a solvent for making larval feed and also to lower the temperature in the hive. Water is also needed to dissolve compounds to organic salts in the nest before being used in the metabolism of cells [8].

3.4. Ash Level

The results of the analysis of the variance of pollen ash content showed a very significant difference ($P<0.01$) and the drying treatment affected the ash content in the pollen. The ash content in pollen is carried out to determine the mineral content and the presence or absence of metal contamination [9]. Ash is an inorganic residue from the combustion process. The remaining inorganic materials include minerals that are not burned in the combustion process. The high ash content of the oven-drying pollen indicates that the mineral content is higher than that of the sun-dried pollen.

The average ash content in pollen is 2.4% [10]. The ash content can be determined by going through the heating process with high temperatures on the material so that only ash is left.

3.5. Carbohydrate

The results of the analysis of the variance of the carbohydrate content of pollen showed a significant difference ($P<0.01$). Based on this, oven-dried pollen has higher carbohydrate content, so it has better quality than bee feed. The treatment increases the effect on the carbohydrate content of the pollen, because the lower the air content in the pollen.

Muchtadi and Ayustaningwarno [11] stated that reducing the water content of foodstuffs will increase the carbohydrate, protein and mineral content. From the results of the study, it was found that the carbohydrate content of oil palm pollen ranged from 58%-61%. This is in accordance with the statement Li *et al.*[12] stated that in 100 grams of dry weight bee pollen there are around 40-85% carbohydrates. Based on this, oven-drying pollen has higher carbohydrate content, so it has better quality than bee feed.

3.6. Dissolved Protein

The content of dissolved protein content of oil palm pollen samples with treatment P0 (12 hours sun-dried) was 2.70% while oil palm pollen samples P1 (12 hours sun-dried + 60 °C oven for 4 hours) was 2.67%. The dissolved protein content in the P0 treatment was greater than the dissolved protein content in P1, this indicates that the drying process affects the dissolved protein content of oil palm pollen. According to the statement of Mondal, *et al.* [13] that the drying process affects the dissolved protein content in a material, the content of dissolved protein content with the sun drying process is higher than the drying process using the oven method.

The material tends to decrease in dissolved protein content along with moisture on drying using the oven method so that the water content affects the dissolved protein content of a material. In addition to the drying process, protein solubility is also influenced by other factors depending on the protein structure, pH, extraction time, temperature, and other intrinsic factors. If the dissolved protein content decreases, the protein quality of the material will also decrease [14]. The results of the analysis of variance showed that the soluble protein content of the oil palm pollen samples P0 and P1 were not significantly different ($P<0.01$), the drying process using a 60 °C oven for 1 hour did not show a significant effect on the dissolved protein content of palm pollen.

Soluble protein is an oligopeptide of a short-chain protein group that is easily digested by the digestive system; therefore the dissolved protein content is one indicator of protein quality in an ingredient [15]. If a material has high soluble protein content, the digestibility of the material may be also high, so that if the oil palm pollen with P0 treatment has a higher dissolved protein content than P1, it can be concluded that the oil palm pollen with P0 treatment had better digestibility than pollen with P1 treatment.

4. CONCLUSION

Based on the results of the study, it can be concluded that oven-drying pollen has better quality than sun-drying, oven drying can reduce water content more so that pollen has a longer shelf life.

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