



Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Effect of tumeric powder (*Curcuma domestica* Val) in feed, on the blood of local duck

Tertia Delia Nova* and Yulia Yellita

Faculty of Animal Husbandry Science Program, Andalas University, Padang, Indonesia

ABSTRACT

This study aimed to determine the effect of turmeric powder (*Curcuma domestica* Val) in feed on the blood of local ducks. The study used 80 head day old duck (DOD), Pitalah male duck, which was placed on the 20 unit enclosure plot, with 4 treatments and 5 replications. The treatments given are A (feed + 0.0% turmeric powder), B (feed + 0.2% turmeric powder), C (feed + 0.4% turmeric powder) and D (feed + 0.6% turmeric powder). The parameters measured were the number of erythrocytes, hemoglobin concentration, and hematocrit percentage, the number of lymphocytes, heterophile, monocytes, eosinophil and basophils. Data obtained during the 11-week maintenance period were analyzed using analysis of variance based on a randomized block design (RBD), followed by Duncan's Multiple Range Test (DMRT). Giving turmeric powder (*Curcuma domestica* Val) up to 0.6% very significant increase ($P < 0.01$) the number of erythrocytes, hemoglobin concentration, hematocrit and total lymphocyte percentage, while the number of heterophile, monocytes, eosinophils and basophils real decrease ($P < 0.05$). The study states that the using of turmeric powder (*Curcuma domestica* Val) up to 0.6% in the diet can improve health status have shown the blood conditions.

Keywords: turmeric powder, local duck, blood conditions

INTRODUCTION

Local duck is one of the livestock germplasm Indonesia. Ducks were developed to maintain the existence of germplasm that have adapted to the local environment. A local duck farm commodities that have the genetic potential and grouped by the name of regions in Indonesia. Examples of ducks in West Sumatra is Pitalah, Kumbang Janti, Kamang and Bayang duck.

Use of commercial feed the ducks or poultry livestock breeders given contain chemicals such as antibiotics, dioxin and harmful microbiology (*Salmonella enterbacteriaceae*) that can leave residues in the body duck, where these residues will be a negative impact on humans consuming. Prevent such occurrence of this is used a variety of herbs that are natural and contain a lot of the benefit to the body of livestock (Harahap, 2008).

Turmeric (*Curcuma domestica* Val), including plants that have many uses, especially the rhizome is used for medicinal purposes of herbs, improves digestion, stimulates bowel movements and increase endurance as well as increased blood levels. Research turmeric (*Curcuma domestica* Val) singly has been widely used in chickens, but the use of turmeric (*Curcuma domestica* Val) in ducks has not been investigated. The use of herbs is the way it is expected to improve the health status and immune systems for poultry, diseases of poultry can be avoided expected loss.

Based turmeric function as an increase in blood levels, as anti-nutritive substances and as animal health (Rohardjo and Rostiana, 2005) conducted this study the use of powder turmeric (*Curcuma domestica* Val) in feed affect the

state of the local duck blood, we know that blood is necessary to transport the components in the body as nutrients, oxygen, carbon dioxide, metabolic, hormonal, and immune.

EXPERIMENTAL SECTION

Research material

Poultry research

Poultry used in this study were male Pitalah ducks aged one day some 80 head, from Nagari Pitalah, Tanah Datar. In the first week is adaptations of duck, to a new environment, then duck feed to be introduced in consumption during the study. Treatment started at the beginning of week 2 up to week 11.

Cages and equipment

Cages used wire floor cages research that 20 plots, with each plot size of 75cm x 60cm x 50cm. Equipped with a feed, drink, and electric lights on each plot as a heating treatment. The tools in this study is spuit 3ml, alcohol 70%, venojek tubes, cotton swab, tube filled with ice, glass objects, cover glass, color Giemsa 10%, and electric scales to the nearest 0.01 gram capacity of 2000 grams.

A Mixture of food

Foodstuffs are used consisting of: yellow corn, rice bran, soybean meal, fish meal, mix top and palm oil. Additives (turmeric powder) form of Turmeric from plantations owned by farmers in Koto Tuo, land around the Andalas University area. Feed the experiment is based on the nutritional needs of local ducks by Bintang *et al* (1997).

To make flour turmeric (*Curcuma domestica* Val)

Flour turmeric (*Curcuma domestica* Val) made from turmeric root, washed, scraped off the outer skin, then thinly sliced. The turmeric slices cooling it to dry, then dried in an oven at a temperature of 60°C, the aim is to make fine powder turmeric (*Curcuma domestica* Val). Turmeric finely pulverized in a blender so that it becomes flour, then sifted on the hole size ranges between 60-80 mesh.

Research metode

Treatment of ducks

The treatment of local ducks at week 2, which is placed on each plot. Treatment 1 is turmeric powder in feed local ducks trial a number of 0% per feed, called A is the control. Treatment 2 that turmeric powder to feed the local ducks trial a number of 0.2% per feed, called B. Treatment 3 that turmeric powder in the ration experimental local ducks feed some 0.4% each, called C. Treatment 4, the turmeric powder to feed the local ducks trial a number of 0.6% on feed, called D.

Blood Sampling

The blood sampling at week 7 and week 11 study, the axillary vein on the ventral wing using spoit tool. continued examination of blood in the Faculty of Animal Physiology Laboratory Animal Andalas University in Padang.

Research Variable

Eritrosit, hemoglobin levels, percentage hematocrit, Leukosit (limfosit, heterofil, monosit, eosinofil and basofil)

Data Analysis

The method of research was conducted in the experimental method. The data obtained are measured with Random Design (RBD) consisting of 4 treatments and 5 replications. Each experimental unit consisted of 4 local ducks.

Model lineari designs were used according to Steel and Torrie (1995), namely:

$$Y_{ij} = \mu + \tau_i + B_j + \epsilon_{ij}$$

Explained:

Y_{ij} = observations to i treatment to j .

μ = the median, common.

τ_i = Effect of treatment to i .

B_j = influence group to j .

ϵ_{ij} = The influence of residual (corr) in the experimental unit that are subjected to i on replay to j .

i = Treatment to 1, 2, 3 and 4

j = Group to 1, 2, 3,4 and 5

The data obtained were statistically analyzed using analysis of variance (ANOVA) and the differences between treatments were tested by Duncan's Multiple Range Test (Steel and Torrie, 1995).

Research Time and Place

Research conducted at the University of Andalas Technical Implementation Unit and Laboratory of Animal Physiology Andalas University of Padang, in February-May 2014

RESULTS AND DISCUSSION

Effect of turmeric powder (*Curcuma domestica* Val) in the feed to total erythrocytes (106/mm) at week 7 and week 11

The average number of erythrocytes in the local ducks after treated flour turmeric (*Curcuma domestica* Val) in feed at week 7 and 11 can be seen in Table 1.

Table 1. Average of Use Turmeric powder (*Curcuma domestica* Val) in the feed to the amount of erythrocytes (106/mm) in Week 7 and Weeks 11

Treatment	Eritrosit week to -7 (10 ⁶ /mm)	Eritrosit week to -11 (10 ⁶ /mm)
A	2,22 ^A	2,44 ^A
B	2,93 ^B	2,59 ^A
C	3,28 ^C	2,79 ^A
D	3,41 ^C	3,44 ^B
SE	0,07	0,17
Signifikan	**	**

SE = Standar Error

** = Very Real Difference (P<0,01)

A = basal feed+0% curcuma powder, B = basal feed +0,2% curcuma powder, C = basal feed +0,4% curcuma powder, D = basal feed +0,6% curcuma powder

Results of analysis of variance showed that the effect of turmeric powder (*Curcuma domestica* Val) in the feed to the number of erythrocytes local ducks at week 7 and week 11 has increased very significantly (P<0.01) to the controls (0%).

Increased erythrocyte, the use of turmeric powder (*Curcuma domestica* Val) due flour turmeric (*Curcuma domestica* Val) contains iron, protein and phosphorus. According to (Rohardjo and Rostiana, 2005), the main content of the flour turmeric (*Curcuma domestica* Val), namely essential oils, curcumin, iron, fat, protein, calcium and phosphorus. Iron is a substance in the body that is closely linked to the availability of the required amount of blood. The main function of iron in the formation of erythrocytes is to transport oxygen from the lungs to the tissues and transports electrons in the process of formation of energy in cells. While Piliang et al (2009), adding that the values of erythrocytes, hemoglobin and hematocrit were normal ducks showed no lack of iron, protein and amino acids necessary for the body's metabolic processes.

Guyton (1997), states that the mechanism of erythropoiesis or red cell formation hemositoblas cells derived from continuously formed from primordial stem cells found in bone marrow. Hemositoblas into shape eritoblas basophils, which began to synthesize hemoglobin, then became eritoblas polikromatofilik containing a mixture of substances basophils and hemoglobin thus shrinking the cell nucleus into the cytoplasm normoblast filled normoblast as hemoglobin.

Table 2. Average of Use flour Turmeric (*Curcuma domestica* Val) in feed for Hemoglobin (g/100ml) at week 7 and week 11

Treatment	Hemoglobin (g/100mL) week to-7	Hemoglobin (g/100mL) week to-11
A	13,20	12,20 ^a
B	14,10	13,40 ^{ab}
C	14,25	14,25 ^b
D	14,30	15,20 ^b
SE	0,3	0,39
Signifikasi	NS	*

Explanation : SE= StandartError

* = Real Difference (P<0,05)

NS= Non Significant

A = Basal feed+0% curcumin powder, B = Basal feed +0,2% curcumin powder, C = Basal feed +0,4% curcumin powder, D = Basal feed +0,6% curcumin powder

Endoplasmic reticulum are reabsorbed so that the cells turned into reticulocyte continue into the blood capillaries. Endoplasmic reticulum in reticulocyte hemoglobin produces little, until two days into the cell nucleus disappear and turn into mature erythrocytes.

Effect of turmeric powder (*Curcuma domestica* Val) in feed on hemoglobin (g/100ml) Week 7 and Week 11

The mean hemoglobin (g/100ml) local ducks after being given flour turmeric (*Curcuma domestica* Val) at week 7 and week 11 are presented in Table 2.

Results of analysis of variance showed the use of turmeric powder (*Curcuma domestica* Val) to 7 IS non significant ($P > 0.05$) in hemoglobin levels at the local ducks, while the use of turmeric powder at week 11, significantly increased ($P < 0.05$) the amount of hemoglobin compared to the control group (0%) flour turmeric (*Curcuma domestica* Val).

According Sturkie (1976) that the level of hemoglobin in the local male ducks 13.3 g / 100ml and the local ducks females 12.7 g / 100ml, while Ismoyowati (2006) reported that hemoglobin levels of local duck production (layer) is 10.81 g / 100ml.

The effect on hemoglobin due to the flour turmeric (*Curcuma domestica* Val) contained in iron, phosphorus, protein, amino acid and Cu (Piliang *et al*, 2009), Iron is contained in turmeric powder (*Curcuma domestica* Val) is a substance in the body that is closely linked to the availability of the necessary amount of blood, so that the presence of iron in the blood will increase in hemoglobin. The hemoglobin levels depends on the number of erythrocytes that affect hemoglobin levels in ducks. The greater the blood erythrocyte hemoglobin levels will increase. This is consistent with the statement Winarsih (2005), that the hemoglobin level is highly dependent on the number of erythrocytes, because the erythrocytes are a time of the largest cell in the blood.

The influence of the use of turmeric powder (*Curcuma domestica* Val) in the ration on hematocrit percentage (%) Week 7 and Week 11

The mean percentage of hematocrit local ducks after treated with the use of turmeric powder (*Curcuma domestica* Val) in feed at week 7 and week 11 are shown in Table 3.

Table3. Average of use powder turmeric (*Curcuma domestica* Val) in feed for hematocrit percentage (%)week 7 and week 11

Treatment	Hematokritweek to-7	Hematokritweek to-11
A	36,40	36,00
B	37,00	37,00
C	38,00	38,80
D	38,80	39,00
SE	1,67	1,59

Explanation: SE = Standart Error

A= ransum+0% tepung kunyit, B= ransum+0,2% tepung kunyit,
C= ransum+0,4% tepung kunyit, D= ransum+0,6% tepung kunyit

Results of analysis of variance showed the use of turmeric powder (*Curcuma domestica* Val) in feed week 7 and week 11 had no effect ($P > 0.05$) hematocrit percentage of local ducks. According Ismoyowati *et al* (2006), that the hematocrit percentage range drake is 36.85%, while according to Isroli (2003) reported the percentage of ducks hematocrit of 39.2%. Increased hematocrit due to the powder turmeric (*Curcuma domestica* Val) contains protein, iron, amino acids, minerals and water (Chattopadhyay, 2004).

The influence of the use of turmeric powder (*Curcuma domestica* Val) in feed against Lymphocytes Week 7 and Week 11.

The average number of local ducks lymphocytes after treated with the use of turmeric powder (*Curcuma domestica* Val) in feed at week 7 and week 11 are shown in Table 4.

Results of analysis of variance showed that the powder turmeric (*Curcuma domestica* Val) in the feed to the local ducks lymphocyte count at week 7 and week-11 very significantly increased ($P < 0.01$) compared with controls (0%).

The average number of lymphocytes in the 7th week of the use of powder turmeric (*Curcuma domestica* Val) in feed 0.2%, 0.4% and 0.6%, respectively 63.40%, 69.80% and 70.00% while at week 11, the number of lymphocytes 66.60%, 71.40% and 81.80%, the highest number of lymphocytes present in flour consumption turmeric (*Curcuma domestica* Val) 0.6%.

Table 4. The average of consumption of turmeric powder (*Curcuma domestica* Val) in the feed to the number of lymphocytes Week 7 and Week 11

Treatment	Limfositweekto-7	Limfositweek to-10
A	58,60 ^A	60,00 ^A
B	63,40 ^{AB}	66,60 ^B
C	69,80 ^B	71,40 ^B
D	70,00 ^B	81,80 ^C
SE	2,25	0,93
Signifikan	**	**

Explanation : SE = Standard Error

** = Higly significant ($P < 0,01$)

A= basal feed+0% tumeric powder, B= basal feed +0,2% tumeric powder,
C= basal feed +0,4% tumeric powder, D= basal feed +0,6% tumeric powder

An increase in the percentage of lymphocytes in the local ducks due to the flour turmeric (*Curcuma domestica* Val) have the ability as immunostimulan, thereby causing an increase in leukocytes into circulation, including lymphocytes (Kohli *et al*, 2005), while according to (Dharmawan 2002 and Jakcson, 2007) an increase in lymphocytes caused partly the decrease heterophile (is relative), lymphocytic leukemia, chronic inflammation (infectious bacteria, viruses, fungi and protozoa), expenditure epinephrine, kortokosteroid deficiency and neoplasia.

Lymphocytes are the biggest part of the leukocytes in poultry, has a function as humoral immunity which is able to attack the invader agent and as immune cells derived from the formation of activated lymphocytes capable of destroying foreign bodies (Guyton, 1997).

Effect of turmeric powder (*Curcuma domestica* Val) in the feed to the number of heterophile Local Ducks Week 7 and Week 11

The average number of heterophile local ducks after treated with the use of turmeric powder (*Curcuma domestica* Val) in feed at week 7 and week 11 are shown in Table 5

Table 5. Mean consumption of turmeric powder (*Curcuma domestica* Val) in the feed to the number Heteofil in Week 7 and Week 11

Treatment	Heterofilweek to-7	Heterofilweek to-11
A	29,00 ^b	29,60 ^C
B	29,20 ^b	25,40 ^C
C	21,00 ^a	22,80 ^B
D	22,40 ^a	14,20 ^A
SE	1,97	0,69
Signifikan	*	**

Explanation : SE = Standard Error

*= Significat ($P < 0,05$) ** = Higly Significant ($P < 0,01$)

A= basal feed+0% tumeric powder, B= basal feed +0,2% tumeric powder,
C= basal feed +0,4% tumeric powder, D= basal feed +0,6% tumeric powder

Results of analysis of variance showed that the use of turmeric powder (*Curcuma domestica* Val) 7 th week significantly reduced ($P < 0.05$) number of heterophile onlocal ducks, while the use of turmeric powder (*Curcuma domestica* Val) at week-11highly significantly to reduced ($P < 0.01$) heterophile number. Based on the results of the study showed that the higher the percentage of heterophile the local ducks reared suspected in sickness, while the lower the percentage of heterophile ducks are in a healthy condition.

According to Jackson (2007), the factors that led to the low number of heterophile partly because of acute inflammation, normal fluctuations (slightly down), neoplasia bone marrow and infection, while an increasing number of heterophile caused by spending epinephrine and corticosteroids, chronic diseases and acute (trauma), an inflammatory process (infection, nonspecific inflammation, necrosis, hemolysis and neoplasia). According to Harvey (2001), the amount of heterophile at a young age is greater than the old age. Flour turmeric (*Curcuma domestica* Val) have the ability immunostimulan same glucocorticoid hormone that causes a decrease in the number of circulating heterophile (Antony *et al*, 1999).

The influence of the use of turmeric powder (*Curcuma domestica* Val) in the feed to the number of local ducks Monocytes in Week 7 and Week 11

The average number of monocytes local ducks, after treated with the use of turmeric powder (*Curcuma domestica* Val) in feed at week 7 and week 11 are shown in Table 6

Table 6. Average of the use of turmeric powder (*Curcuma domestica* Val) in the feed to the number of monocytes in the local ducks in Week 7 and Week 11

Treatment	Monosit week to-7	Monositweek to -11
A	8,40	8,40 ^B
B	5,60	5,40 ^A
C	6,40	9,20 ^B
D	5,00	5,00 ^A
SE	0,94	0,53

Explanation : SE = StandardError

A= basal feed+0% tumeric powder, B= basal feed+0,2% tumeric powder
C= basal feed +0,4% tumeric powder, D= basal feed+0,6% tumeric powder

Number of monocytes obtained the results of the study are in the normal range between 5.00 to 8.40%, in accordance with the opinion of Darmawan (2002) that the normal range of monocytes percentage is 3-9%, so the percentage of monocytes local ducks are still within the normal range. According to Kohli *et al* (2005), the ability of curcumin in turmeric powder (*Curcuma domestica* Val) can stimulate the adrenals to release the hormone kalenjerkortisosteroid, thereby increasing circulating monocytes. A decrease in the percentage of monocytes is because the content of curcumin found in turmeric powder (*Curcuma domestica* Val) that functions as an anti-inflammatory, thereby preventing the occurrence of disease.

Monocytes are the biggest leukocytes have 15-20µm diameter and has a function as precursors to macrophages where these cells will digest and read antigen, the cell's cytoplasm is divided into two parts, namely the brightly colored and darker colored part (Campbell, 1995), while according to Guyton (1997), monocytes serves to memfagositosis microorganism cells and necrotic cells

The influence of the use of turmeric powder (*Curcuma domestica* Val) in the feed to the number of local ducks Eosinophils in Week 7 and Week 11

The average number of eosinophils local ducks after treated with the use of turmeric powder (*Curcuma domestica* Val) in feed at week 7 and week 11 are shown in Table 7.

Table 7. The average consumption of turmeric powder (*Curcuma domestica* Val) in the feed to the number of Eosinophils in Week 7 and Week 11

Treatment	Eosinofilweek to-7	Eosinofilweek toke-11
A	1,00	0,60
B	0,20	0,60
C	0,60	0,60
D	0,40	0,40
SE	0,26	0,23

Explanation : SE = Standard Error

A= basal feed+0% tumeric powder, B= basal feed+0,2% tumeric powder,
C= basal feed +0,4% tumeric powder, D= basal feed+0,6% tumeric powder

Based on the results of the research that the use of turmeric powder (*Curcuma domestica* Val) in feed week 7 and week 11 did not affect ($P > 0.05$) eosinophil count on the local ducks. The average number of eosinophils in week 7 and week 11 the used of flour turmeric (*Curcuma domestica* Val) ranged between 0.00% -1.00%.

The use of powder turmeric (*Curcuma domestica* Val) in feed can reduce the number of eosinophils in the local ducks, because flour turmeric (*Curcuma domestica* Val) serves as an anti-inflammatory in the body, so that it can prevent the occurrence of disease (Kohli *et al*, 2005).

According to Guyton (1997), eosinophils are produced when the parasitic infection and in the event of an allergic reaction. At the time of an allergic reaction to mast cells and basophils release eosinophil chemotactic factor, so that eosinophils migrate to the inflamed tissue.

The influence of the use of turmeric powder (*Curcuma domestica* Val) in the feed to the number of local ducks Basophils in Week 7 and Week 11

The average number of basophils in the local ducks after treated with the use of turmeric powder (*Curcuma domestica* Val) in feed at week 7 and week 11 are shown in Table 8.

Table 8. The average consumption of turmeric powder (*Curcuma domestica* Val) in the feed to the number of Basophils in Week 7 and Week 11

Treatment	Basofilweek to -7	Basofilweek to-11
A	3,20 ^b	3,00 ^B
B	1,60 ^a	2,20 ^A
C	1,80 ^a	2,00 ^A
D	2,20 ^a	1,80 ^A
SE	0,31	0,24
Signification	*	**

Explanation : SE = Standard Error

*= Significant (P<0,05) **= highly Significant (P<0,01)

A= basal feed+ 0%tumeric powder, B= basal feed + 0,2% tumeric powder

C= basal feed + 0,4% tumeric powder, D= basal feed + 0,6% tumeric powder

Results of analysis of variance showed that the effects of the use of turmeric powder (*Curcuma domestica* Val) in the feed at the 7th week significantly reduced (P<0.05) number of basophils local ducks, while the used of flour turmeric (*Curcuma domestica* Val) in feed in week 11 very significantly reduced (P <0.01) number of basophils.

Lowest number of basophils found in the use of turmeric powder (*Curcuma domestica* Val) 0.6%. Decreasing the percentage of basophils in the local ducks because the content kurkuminoid serves to menentralkan toxins, lowering cholesterol levels, blood, anti-bacterial and antioxidant antidote compounds harmful free radicals. Increasing the percentage of basophils in the body resulting in inflammation, leukemia and the healing phase of infection (Kohli *et al*, 2005).

According to Ganong (1995), serves as the basophil histamine release in the damaged tissue to increase blood flow which will attract heterophile and facilitate tissue repair. Basophils contain heparin, histamine, hyaluronic acid, chondroitin sulfate, serotonin and several factors kemotik. Heparin prevents blood clotting, while functioning vasoliditas so basophil histamine exit (Guyton, 1997). In birds and poultry basophils participate in hypersentivitas reactions, mediator of platelet activity and acute inflammation.

CONCLUSION

The use of powder turmeric (*Curcuma domestica* Val) up to 0.6% can improve the health status of the local duck, which can be seen on the condition of the blood by increasing the number of erythrocytes, hemoglobin concentration, hematocrit percentage, and the number of lymphocytes in the blood, while the number of heterophile, the number of monocytes, the number of eosinophils and basophils amount to be reduced. Further research needs to be done to increase the use of turmeric powder (*Curcuma domestica* Val) and additional other herbal plants.

REFERENCES

- [1] Antony S, Kuttan R, Kuttan GA. **1999**. *Immunol Invest*. 28: 5-6.
- [2] Bintang, I.A.K., Silalahi, M.,A.G. Natamijaya., dan Rahardjo, Y.C.**1997**.2(4): 237-241.
- [3] Campbell, T.W. Iowa. Iowa State University Press. Ames. Iowa. United States of America. **1995**.
- [4] Chattopadhyay, I., K. Biswas, U. Bandyopadhyay and R. K. Banerjee. *J. Curr. Sci.* **2004**, 87: 44-53.
- [5] Dharmawan, N.S. Denpasar: Pelawa Sari, **2002**.
- [6] Ganong, W. F. EGC. Jakarta, **2002**.
- [7] Guyton, A.C and J.E. Hall. **1997**. Ed.9.
- [8] Harahap, Z.H. Thesis. Institut Pertanian Bogor, **2008**.
- [9] Harvey, J.WW.B. Saunders Co., **2001**.
- [10] Ismoyowati, Prayitno, and Ida. F. Fakultas Peternakan UNSOED. *Animal Production*, **2003** Vol.5, No.I.
- [11] Ismoyowati, T.Yuwanta, J.H.P. Sidadolog, and S. Keman. Fakultas Peternakan UNSOED and Fakultas Peternakan UGM. *Animal Production*, **2006**, 8, 2, 88-93.
- [12] Isroli. *Skripsi*. Fakultas Peternakan Universitas Diponegoro. Semarang, **2003**.
- [13] Jackson, M.L. USA: Blackwell Publishing, **2007**.
- [14] Kohli, K, Ali. J, Ansari. M.J and Raheman. *Z. Indian. J. Pharmacol.*, **2005**, 37: 141-147.
- [15] Piliang, W.G. D. A. Astuti and W. Hermana. Prosiding seminar hasil-hasil penelitian Institut Pertanian Bogor, **2009**, 27-39.
- [16] Rohardjo, M and Rostiana, O. Balai Penelitian Tanaman Obat dan Aromatika Sirkuler. **2005**.
- [17] Steel, R.G.D. dan J.H. Torrie. Gramedia, Jakarta, **1991**.
- [18] Sturkie ,P.D and Grimminger. 1st Published. Ithaca. New York: Cornell University Press, **1976**.
- [19] Winarsih, W. Thesis. Pasca Sarjana. Institut Pertanian Bogor. Bogor, **2005**.