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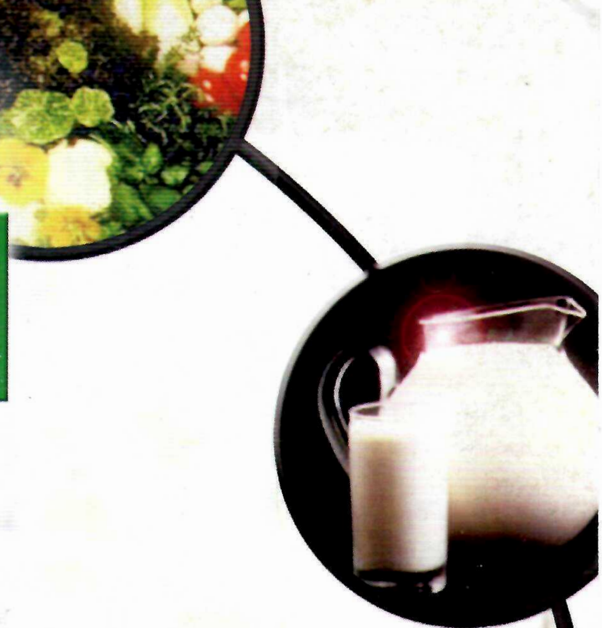
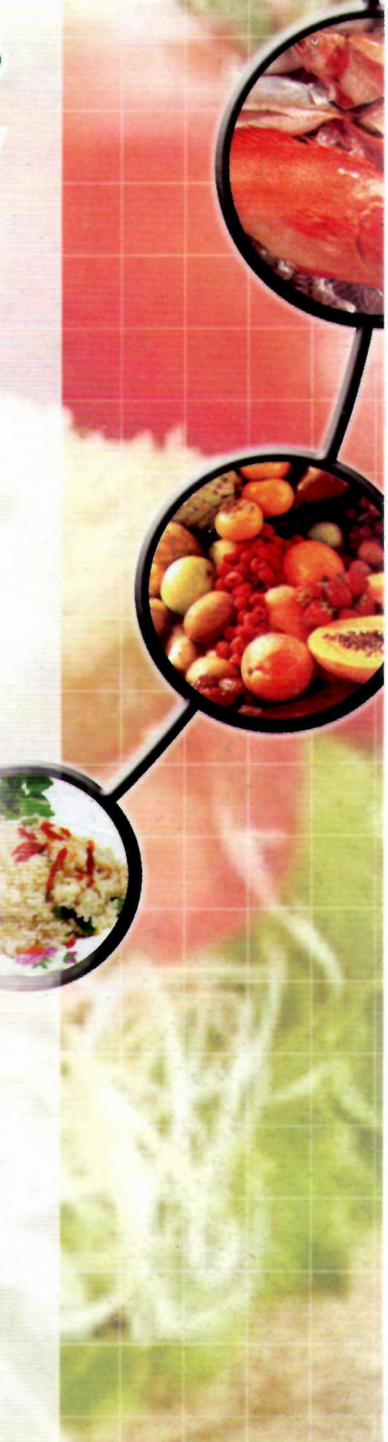


the 7th national student conference

ON FOOD SCIENCE AND TECHNOLOGY

HEALTHY FOOD OR FOOD FOR HEALTH ? FROM NUTRITION TO FUNCTIONALITY



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PREFACE

This is the 7th National Student Conference on Food Science and Technology organized by Department of Food Technology, Faculty of Agricultural Technology, Soegijapranata Catholic University, Semarang. The main theme of this conference, **"Healthy Food or Food for Health? From Nutrition to Functionality"**, implies the new efforts for documenting as well as improving the students research culture on food science and technology in Indonesia.

This conference was designed especially for students to share their research findings and vision on food science and technology. Furthermore they could improve their presentation capability in English. Presentation covered following topics :

Food Safety and Quality
Food Processing and Engineering
Nutrition and Functional Food
Food Microbiology and Biotechnology

In order to response the newest trend on food issues and encourage the students with an international academic atmosphere, there are plenary presentation about **"Developing Functional Food in Indonesia"**, **"Recent Trend in Health and Functional Food"**, and **"Flavor Trend for Health Food : Citrus"** that delivered by the expert and competence academicians.

The Organizing Committee is gratefull to all the honorable speakers, participants and sponsor companies for joining this gathering and for their valuable contribiton to the Conference

Semarang, June 2007

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THE EFFECTIVENESS OF XANTHORRHIZOL IN REDUCING FAT CONTENTS OF CHICKEN BROILER CARCASS

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ABSTRACT

Broiler chickens are most susceptible to stress, which come from various unavoidable factors, such as noise, physical contact with other chickens, and weather. For generations Curcuma xanthorrhiza has been used traditionally as anti-stress and anti-inflammatory agents, and a scientific proof has been given for its anti-proliferative activities. Sesquiterpene compound xanthorrhizol has been determined responsible for these activities. This study explored the effectiveness of xanthorrhizol in decreasing of stress main factor, i.e. fat content in the body tissue of broiler chickens. Xanthorhrizol treatment at 10–15 ppm per kg chickens body weight significantly reduced fat content in the breast and leg muscle tissue from 3,727.86 mg/100 g to 3,149.74 mg/100 g (17%) and from 716.90 mg/100 g to 592.06 mg/100 g (15%) respectively, stable feed intake and growing rate, reducing FCR to 1.590 compared to control 1.697 (0.107 reduction), reducing mortality up to 3.842%, but increasing body weight up to 311 g/chicken during 32 days. This lower fat content in the body tissue awaits more detailed investigation on the effect of the compound on the quality of chicken meat.

Keywords: *Xanthorrhizol, Fat Contents, Chicken Broiler*

INTRODUCTION

Broiler chickens are very sensitive to stress. The stress could come from various unavoidable factors, such as noise, physical contact with other chickens, physical injury, and weather. Once a chicken get stress, it will be depressed, decreased food intake, reduced weight gain, immobility, paralysis and finally death. In average mortality rates due to stress could reach of 2 – 10%, depends on management, ventilation, stocking density, litter conditions, and farm hygiene or concurrent infections. Different from diseases which mostly affect chicken at certain age, stress could happen since day-old-chicken (DOC)-2 up to ready to harvest, i.e. 30 – 42 days old.

A series of studies reported that chicken stress was due to the sudden reaction of blood pressure which lead the flooding of the blood to the brain, when the chicken receives unexpected stress factors (Sanz et al., 2000a). The pressure could happen because of increase fat content in the body tissue (Sanz et al., 2000b; Sanz et al., 2000c). Although the mechanism has not been determined, over the last decades it was a significant evidence that the 2% increase of fat contained in the muscles' tissue resulting in more that 3% chicken broiler mortality due to stress (Rutkowski., et al., 1998). The addition of vitamin C in to the chicken diet is commonly operated in the farm, to reduce the stress. However, this way just increases the chicken fitness against some of stress factors, particularly weather, but this does not meet with the stimulation of the increase of blood pressure (Takahashi et al., 2006).

For generations, Javanese people has used rhizome of *Curcuma xanthorrhiza* Lin. as an anti-stress (Yasni and Imaizumi, 1991) as well as anti-inflammatory agent (Claeson and Panthong, 1993; Claeson and Pongprayoon, 1996), antibacterial (Hwang and Shim, 2000b; 2000b.), antimicrobial (Hwang and Shim, 2000), anti-hepatotoxin (Lin and Lin, 1995), and antioxidative (Masuda and Isobe, 1992). Further studies reported that sesquiterpene compound of xanthorrhizol is one responsible for these activities (Aminah, 1996). Recent investigation documented that xanthorrhizol ($C_{15}H_{22}O$) or xanthorrhyzol, is an ally-cyclic hydrobenzene compound, which also named as phenolic hydroxy-ar-curcumene or hydroxycurcumene, aromatic, volatile, strong smell at room temperature (Lim et al., 2005), the boiling point is 146^0C, melting point is – 46^0C, molecular weight is 218.34 (Zwaving and Bos, 2006), colourless, sensitive to low frequency lighting, and having chemical structure as shown on Figure 1. (USA Patent 20050261162, 2005). The compound can be separated from the similar compound mechanically, using ambient temperature and extreme diurnal pressure, under zero lighting conditions (Indonesia Patent No. P.002[illegible]

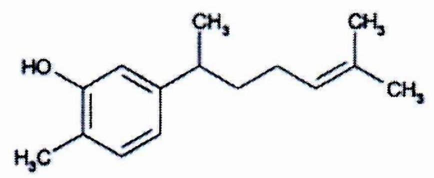

Figure 1. Chemical structure of xanthorrhizol ($C_{15}H_{22}O$)

The reagent can be activated in various ways, such as suppresses the activity of cyclooxygenase-2 and inducible nitric oxide syntheses (iNOS) enzyme which are related to the inflammatory reaction to improve its pharmacokinetics (Yamazaki and Maebayashi, 1998a;b). Furthermore the activated xanthorrhyzol reagent will preventing and treating cancer and treating an inflammation, more particularly, which inhibits generation of mutation and tumor, and enhances the activity of detoxification enzyme of carcinogen, and induces apoptosis of cancer cell (USA Patent No. 20050261162).

Previous study reported that addition of *C. xanthorriza* rhizome significantly reduced triglyseric acid in the body tissue of rat ((Yasni and Imaizumi, 1993). Since the factor has been identified as the main stimulator to increasing blood pressure to the brain, the application of xanthorrhizol is therefore will be possible to reduce chicken stress and finally to reduce mortality. This study explored the effectiveness of xanthorrhizol extracted from *C. xanthorriza* Lin. rhizome in decreasing of chicken stress and mortality.

MATERIALS AND METHODS

Xanthorrizol Preparation. Active compound of xanthorrizol was extracted from mature and fresh rhyzome of *C. xanthorriza* Lin. The extraction was conducted by operating ambient temperature and diurnal pressure, following the procedure as described in Indonesia Patent No. P.00200500691. Extracted xanthorrizol was then mixed together with the extract of *Curcuma aeruginosa* Roxb. rhyzome, *Piper retrofractum* Vahl. seeds, *Zingiber aromaticum* Vahl. rhyzome, Val., and extract of *Aegle marmelos* L. Corr. fruit, to provide growth regulator, growth stimulator, and immuno-modulator respectively, following the procedure as described in Indonesia Patent No. P.00200500690.

Field Studies. The field studies were conducted in two stages. First stage, study 1., was conducted to define the most significant concentration of xanthorrizol in reducing sugar concentration in the blood and fat content in the body tissue of broiler chickens. The pre-treatment was made in four levels of concentration ranges; 0 ppm, 5–10 ppm, 10–15 ppm, and 15–20 ppm per kg chicken body weight. The concentration range was organized to meet field application, to which each level of concentration can be applied in a certain period of chicken ages. The treatment was applied at the filed laboratory of PT. Indoherb Sains Medika (PT. ISM), Cluwak, Pati, Central Java, during March–April 2006. Each level of concentration was managed using 20 chickens; 80 chickens in total. Randomly chosen 5 samples were taken from each treatment for fat content studies.

At the end of the experiment ten chickens per group were taken randomly as a representative sample and were slaughtered. The carcasses were dissected manually and the following criteria were recorded: carcass weight and dressing percentage (carcass weight as percentage of final body weight), weights of breast meat, legs (thigh + shank). These values were expressed as a percentage of the cold carcass weight. Basic chemical analysis was made at dry matter of the muscles (Pikul, 1993). Crude fat was determined using Soxhlet method as described by James (1995), and meat pH was measured using electonic pH-meter.

Based on the results of Study 1., the most appropriate dosage level of xanthorrizol addition in the chicken diet then would applied as experiment treatment in the second stage, Study 2. with untreated chickens as the control. Study 2. was conducted in the same location. Each treatment was repeated 10 times, one flock each, during the period of October – December 2006. Each flock consists of 20 chickens; 400 in total. Chickens growth rate, percentage of mortality, feed intake, and feed conversion ratio (FCR) were measured. The growth rate was measured twice per week, by weighing randomly chosen 10 chicken per flock, then calculated as an average per chicken sample. The mortality was counted everyday since DOC-2 until harvested, i.e. 32-nd days old, and the total died chicken at each flock was divided with total chicken population in the flock at the time of chick in. Feed intake was calculated from daily consumption, and FCR was calculated as total weight of chicken at time of harvesting divided by total feed intake since chick in per flock. Frequently stress treatment was conducted naturally by placing the chicken flock close to road, which mostly crowded, noisy and dusty at every traditional market-day of "Kliwonan".

Data fat content and pH both from breast and leg obtained in Study 1. was analyzed using single factor analysis of variance in four levels of experimental treatment, i.e. the dosage of xanthorrhizol. The differences between the treatment means was analysed using a multiple comparation technique, at 95% degree of confidence. Data mortality, chicken weight, and FCR obtained from Study 2. which comprised of two levels treatment, were compared using independent two-tailed T-test at 95% degree of confidence.

RESULTS AND DISCUSSIONS

The effect of xanthorrizol addition on fat content in muscles' tissues of chicken broiler. Addition of xanthorrizol in the broiler chicken diet significantly reduced fat in the chicken muscle. addition on fat content in muscles' tissues of chicken broiler, both at the leg and breast. The addition of xanthorrizol up to the range of 10 – 15 ppm, reduced fat content of chicken breast from 3,727.86 mg/100 g to 3,149.74 mg/100 g (17%) of chicken muscle, and was significantly different at 95% degree of confident. The further addition to 15 – 20 ppm resulting in the lower fat content at 3,058.98 mg/100 g, however it was not significantly different from those resulted by 10 – 15 ppm treatment.

A similar decreasing mechanism also found in leg, where the addition of xanthorrizol up to the range of 10 – 15 ppm, reduced fat content from 716.90 mg/100 g to 592.06 mg/100 g (15%) of chicken muscle. The xanthorrhizol dosage below than this level (5 – 10 ppm) did not significantly significantly different from control, and beyond this level (10 – 15 ppm) did not significantly different from 10 – 15 ppm (Table 1.). Referring to these results, xanthorrizol dossage at 10 – 15 ppm per kg chicken body weight, sound to be the most appropriate level to apply in commercial areas.

Table 1. Comparrison of fat content (mg/100 g) and pH in muscles' tissues amongst variaous zanthorrhisol treatment

Xanthorrizol	Fat content (mg/100 g)		PH	
Dosage	Leg	Breast	Leg	Breast
0 ppm	3,727.86 a	716.90 a	6.2 a	5.8 a
5–10 ppm	3,481.72 ab	676.83 ab	6.0 bc	5.7 ab
10–15 ppm	3,149.74 bc	592.06 bc	6.0 bc	5.6 b
15–20 ppm	3,058.98 c	556.18 c	5.9 c	5.6 b

Note: Figures followed by the same letter, indicates significantly different at 95% degree of confidence in column

The decrease of fat content is in agree with results documented by previous researchers, that xanthorrhizol reduced the levels of serum glucose and triglyceride, fatty acid desaturation in rat (Yasni and Imaizumi, 1993; 1991). Some workers reviewed that free three methyl are available to reacting with other hydrogen bounding of lipid, by which the reaction will left the inactivation of the lipid donor. This mechanism will happen when the methyls are activated, and this is suggested to be the one which led to the effectiveness of the compound in inhibiting cancer cell (Claim No. 8, USA Patent No. 20050261162).

The analysis on meat pH, it was demonstrated that the pH of the breast muscles was comprised in the range from 5.6 to 5.8, whereas in the leg muscles it ranging from 5.9 to 6.3 (Table 1). Previous researchers reported that breast muscles possess larger quantities of glycogen (Allen and Foegeding, 2001). This might be relevant with other investigation that after slaughter, these breast muscles show lower pH than leg muscles, due to slower glycogen transformation in the leg compared to breast (Trout and Schmidt, 2004).

The effect of xanthorrizol addition the on production aspects chicken broiler. The study recorded that addition of xanthorrizol at the level of 10–15 ppm significantly reduced mortality up to 3.842% to 2.875% compared to control 6.717%. By 32nd day of growing, the treatment also increasing chicken body weight to 1.759 kg/chicken compared to control 1.449%; increased 0.311 kg/chicken, and increasing feed efficiency by reducing FCR to 1.590 compared to control 1.697, which means reducing feed intake 0.107 kg/kg body weight (Table 2).

Table 2. Comparrison of Mortality (%), Chicken Weight (kg/chicken), FCR of chicken broiler under variaous zanthorrhizol treatment

Parameter	Treatment	Figures
Mortality (%)	Treatment	2.875 b
	Control	6.717 a
Chicken Weight (kg/chicken)	Treatment	1.759 a
	Control	1.449 b
FCR	Treatment	1.590 a
	Control	1.697 b

Note: Figures followed by the same letter, indicates significantly different at 95% degree of confidence in column at each parameter

The mortality of the treated chicken appeared to have a similar pattern as what happened in the control, and was happening at regular basis, i.e. run for every 4 – 5 days (Figure 1). This is due to the fact that the flock pen were located at the near road, where a regular noise happen at every 5 days, i.e. Javanese calendar-day, Kliwonan, which has 5-day cycle. Referring to Figure 1., it was clear that xanthorrhizol mechanism was on the reduction of mortality rate was by declining the rate of stressed chicken, which resulting in the lower rate of mortality. Interestingly, Figure 1. shows that after 15th day, the mortality rate of treated chicken was significantly reduced, and even after 20th day, the was no chicken died. On the other hands, the mortality rate of untreated chicken was apparently increased in the last two weeks. The last condition was in agreed with chicken growth physiology, that the bigger chicken the feed intake will be increased. The increased in feed intake will lead to more viscous the blood, which will resulting in more sensitive to stress factors (Sands and Smith, 1999).

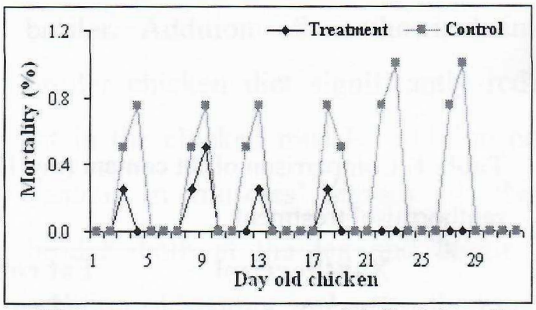

Figure 1. Comparrison of daily Mortality Rate (%) of chicken broiler under variaous zanthorrhizol treatment

On the other hands, the mortality rate of the treated chicken was decline, whereas the body weight was increased, and the increase clearly seen it stronger differences when the chicken getting older (Figure 2). Classically, the bigger chicken will lead to the higher feed intake, which means the risk of getting stress would be higher, and consequently the mortality rate would be higher. Since the study found that the mortality rate was lower, the mechanism of the xanthorrhizol might run in three mechanism. Firstly, xanthorrhizol-treated chicken would have no growth stagnant, which means the growing rate would run steadily. Under a stable growing rate, the chicken would not wasting energy to recover the stagnant growth (Pesti et al., 2002). Stress induction during first stage of growth (2nd – 15th day) wasted up to 6% of energy (Peebles et al., 2002a), whereas when stress induced at production stage (after day 15th) it would waste up to 17% (Peebles et al., 2002b).

The second mechanism, the lower fat concentration in the muscle tissue, the lower stress effect would be accepted by chicken. Sands and Smith (1999) demonstrated that chicken treated with low concentration of fat having more tolerant to heat stress. Similarly, Wiseman and Salvador (2001) showed that low dosage of saturated fat in the chicken diet, help reducing mortality rate during growth and transportation. Higher fat content has been proven to increase sensitiveness of chicken to ammonia accumulation (Lien et ll., 1999), water stress (Pesti, 1999), and reduce glucose distribution (Takahashi et al., 2006). The third mechanism was xanthorrhizol helped in distributing the absorbed nutrient in to the body tissues (Masuda and Isobe, 1992). These three mechanisms perhaps which explain the higher daily gain of the treated chicken, as shown on Figure 1.

Increasing proportions of fat and moisture were related to increases in juiciness and tenderness of the meat (Allen and Foegeding, 2001), however, higher fat content reduced the tenderness of frankfurt type sausages produced (Trout and Schmidt, 2004). Some other food product, such as bologna, the juiciness and tenderness of were more dependent on moisture but was decreased when fat content in the meat beyond 3.7% (Kroliczewskai et al., 2005). Highly fat content also clearly reduced the nugget appearance (Mitta, 2005). Based on these research and reviews, this results awaits more detailed investigation on meat quality, both for consumption and for industrial-based food processing.

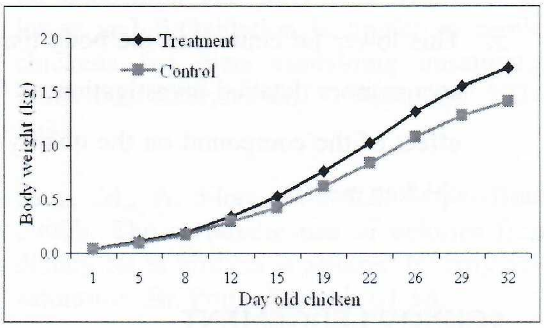

Figure 2. Comparison of daily gain of body weight of chicken broiler under various zanthorrhizol treatments

CONCLUSSIONS

1. Xanthorhrizol treatment at 10–15 ppm per kg chickens body weight significantly reduced fat content in the breast from 3,727.86 mg/100 g to 3,149.74 mg/100 g (17%) and in leg muscle tissue from 716.90 mg/100 g to 592.06 mg/100 g (15%)

2. The treatment also resulted in stable feed intake and growing rate and increase the efficiency in feed conversion, shown in the reduction of FCR to 1.590 compared to control 1.697 (0.107),

3. The reagent also reduced mortality up to 3.842%, but increasing body weight up to 311 g/chicken during 32 days.

4. Three mechanisms might be involved in the efficient feed and growth of the chicken treated by xanthorrizol, limiting energy waste due to the absence of stagnant growth, reducing stress effects,

and improving distribution of absorbed nutrient

5. This lower fat content in the body tissue awaits more detailed investigation on the effect of the compound on the quality of chicken meat.

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