The effect of *Caesalpinia sappan* extract on body weight and carcass weight of bucks (*Cuniculus forma domestica*) exposed to heat stress

B Agustono1,2, D L Safitri3, A L Saputro3, R A Prastiy4, N M Kusuma2, E D Y Sari2

1Division of Animal Husbandry, Faculty of Veterinary Medicine, Jl. Mulyorejo, Kampus C, Universitas Airlangga, Surabaya, Indonesia
2Veterinary Medicine, Faculty of Veterinary Medicine, Jl. Mulyorejo, Kampus C, Universitas Airlangga, Surabaya, Indonesia
3Division of Clinic Veteriner, Faculty of Veterinary Medicine, Jl. Mulyorejo, Kampus C, Universitas Airlangga, Surabaya, Indonesia
4Division of Reproduction Veteriner, Faculty of Veterinary Medicine, Jl. Mulyorejo, Kampus C, Universitas Airlangga, Surabaya, Indonesia

Abstract. The aim of this research was to determine the effect of *Caesalpinia sappan* L. extract on body weight and carcass weight of bucks exposed by heat stress. This research used a completely randomized design with 4 treatments and 5 replications. The experimental animal were 5 month old bucks of rex type. The bucks were divided into 4 groups and given different treatments for 28 days, namely K+ (complete feed + heat stress), K- (complete feed), P1 (complete feed + *Caesalpinia sappan* L. 100mg/kg feed + heat stress), and P2 (complete feed + *Caesalpinia sappan* L. 300 mg/kg feed + heat stress). The observed variables were the body weight and the carcass weight of the bucks. Parametric data was analyzed using ANOVA. The average body weight was K+ (2220.00), K- (2239.80), P1 (2241.60), P2 (2242.00). The average carcass weight was K+ (1132.40), K- (1232.00), P1 (1233.00), P2 (1233.20). The results of study showed that there was a significant difference (P<0.05) between the treatment and control group. Based on the research conducted, it can be concluded that the administration of *Caesalpinia sappan* L. extract can maintain the body weight and carcass weight of buck exposed to heat stress.

1. Introduction

Livestock in Indonesia today growing rapidly in the field of cattle, goats, chickens, buffalo and ducks, while rabbits are less developed. Rabbit livestock are underdeveloped due to lack information about the products produced and the economic value of rabbits to the public [1]. The maintenance of rabbits in tropical climates such as Indonesia has many obstacles, especially during the dry season which results in high temperatures reaching 34°C [2]. The ideal environmental temperature for rabbits is 21 ± 20°C while at 32 ± 20°C it can cause rabbits to experience heat stress [3]. This can cause stress on rabbits and can have negative impacts such as decreasing feed consumption, growth rate, body weight, which can result in large losses [3,4]. The definition of heat stress based on the Association of Farmworker Opportunity Program (AFOP) is the loss of the body’s ability to maintain homeostasis which can be measured by increasing head and body temperature in rabbits [2,5]. Stress is a condition in livestock that causes an increase in temperature or other stressors that come from outside or from inside the livestock [6]. Efforts can be made to reduce stress in livestock by adding external antioxidants.

One of the medicinal plant species that can be used as traditional medicine and as an antioxidant is the secang plant (*Caesalpinia sappan* L.). Secang wood contains 5 active compounds related to flavonoids. These compounds are in the form of brazilin, chalcone and sappanin, sappan calchone which can be used as primary and secondary antioxidants [7–10]. The content of brazilin compounds in secang wood can inhibit the protein inhibitor of apoptosis survivin and is involved in the activation of caspase 3 and caspase 9, so that it can treat cancer [11–13].
Secang contains phenolic compounds such as flavonoids, which have antioxidants as free radical scavengers [14]. Sources of free radicals can come from air pollution, cigarettes, ultraviolet radiation, alcohol, anesthetics, pesticides, X rays, and chemotherapy. The increase in free radicals in the body can cause the body's antioxidant defense system to be ineffective which acts as a protector of free radical attacks so that it can cause oxidative stress, to prevent stress, an antioxidant supplement is needed [9,11,15,16].

2. Materials and Methods
2.1. Experimental design
The experimental animals in this study used 100 rex’s buck with the age of 5 months. Rabbits used are in healthy condition. The experimental animals used were divided into 4 treatments with each treatment having 5 replications. This study used a completely randomized design (CRD) which consisted of four treatments by repeating five times. Each treatment consists of K+ (complete feed + heat stress), K- (complete feed), P1 (complete feed + secang wood extract 100 mg / kg feed + heat stress) and P2 (complete feed+ extract of secang wood 300 mg / kg of feed + heat stress) given for 4 weeks. Heat stress is made by giving heat exposure made from a 5 watt bulb for 12 hours. The materials used in this study used standardized basalt feed then given a feed additive of secang wood extract, drinking water, disinfectant, antiseptic, individual rabbit cage, feed bin, drinking bowl, 5 watt bulb net, pellet maker, extraction maker and weighing equipment. Digital.

2.2. Preparation of Secang Wood Extract
The first process of making sappan wood extract is to weigh 1 kg of sappan wood powder. Secang wood powder is soaked in a glass jar, adding 5 liters of 96% ethanol, then soaked for ± 3 days. Simplicia filtration on a filter machine to produce filtrate, then evaporated for ± 4 hours to produce sappan wood extract. The sappan wood extract was weighed and then mixed the sappan wood extract with 1.5% CMC Na in a spray bottle. Place the basal feed on the baking sheet, spray the feed until it is homogeneous. Place in the oven for 3-4 hours at 45°C.

2.3. Rearing system
Preparation of the cage and all equipment that will be used are cleaned first and then using a disinfectant to disinfect the cage. Places for feeding and drinking that have been cleaned are soaked using an antiseptic. Newly arrived rabbits are adapted for 7-10 days, given forage and concentrate feed gradually adding feed additives until they can be completely replaced and drinking water. Maintenance is carried out according to the desired treatment. Rabbit rearing was carried out for 4 weeks. Feed treatment was given every day as much as 180 g/head. Feed treatment was given twice a day, namely in the morning at 06.00-07.00 am and afternoon at 4.00-5.00 pm. The heat stress treatment begins after the adaptation process is complete. The manufacture of heat stress is carried out by providing heat exposure made from a 5 watt light bulb. Provision of heat exposure from the light bulb starts at 06.00 am and is turned off at 04.00 pm. The light bulb is adjusted using a thermoregulator to adjust to the desired temperature. Exposure to heat stress was carried out for 12 hours [17].

Research data collection for body weight was carried out at the beginning of the treatment period until after the four-week treatment period. Body weight was obtained by weighing (g/head) at the end after rearing. Recording the results of weighing rabbits was carried out every week to determine the increase in body weight from the first treatment to the end of the maintenance period.

Research data collection for carcass weight was carried out by weighing the rabbit's body after slaughter. The rabbit is slaughtered by cutting the respiratory tract, digestive tract, and blood vessels (jugular vein) using a sharp knife, then the rabbit is observed until the blood does not come out which indicates that the rabbit has died completely. After slaughtering the rabbit, the blood, head, skin, legs, tail, digestive tract and contents are reduced and the contents of the chest cavity except the kidneys. Each rabbit was weighed from the beginning before the treatment period at the beginning of the first
week after the adaptation period to determine the body weight and carcass weight. The data obtained and collected during the study will be analyzed using SPSS Version 26.0 software. The data was tested by Analysis of Variance p< 0.05 SPSS v.26 and if there was a significant difference, it would be continued with Duncan’s multiple distance test (5%).

3. Results and Discussion

3.1. Body Weight

Table 1. Score mean and standard deviation of body weight of buck for each treatment.

| Treatment                                      | Mean ± SD          |
|------------------------------------------------|--------------------|
| K+ : Complete feed + heat stress              | 2220.00 ± 3,741    |
| K- : Complete feed                            | 2239.80 ± 5,263    |
| P1 : Complete feed + secang wood extract 100 mg / kg feed + heat stress | 2241.60 ± 2,880    |
| P2 : Complete feed + secang wood extract 300 mg/kg pakan + heat stress | 2242.00 ± 4,690    |

The results of data analysis using analysis of variance (ANOVA) showed that the feed additive of secang wood extract on the body weight of male rabbits was significantly different (p <0.05), between K + and K-, P1 and P2 there were significant differences, K - with P1 and P2 there is no real difference, P1 and P2 there is no real difference. The lowest body weight result in this study is K +. Rabbit growth can be influenced by several factors, including nutritional intake including protein, fat and starch [18]. Protein has an important role in the body's metabolic process which can increase cut weight. Feed is also a major influence for rabbit growth [19]. Protein has an important role in the body's metabolic process which can increase cut weight. Different levels of feed consumption can result in different nutritional content that enters the rabbit so that the body weight of the rabbit will be different from the weight of the slaughtered [20]. Weight gain can be influenced by factors of feed consumption and ambient temperature, the ideal ambient temperature for rabbits is 18ºC with 60-80% humidity [17].

3.2. Carcass Weight

Table 2. Score average and standard deviation of carcass weight of buck for each treatment.

| Treatment                                      | Mean ± SD          |
|------------------------------------------------|--------------------|
| K+ : Complete feed + heat stress              | 1132.40 ± 1,949    |
| K- : Complete feed                            | 1232.00 ± 3,000    |
| P1 : Complete feed + secang wood extract 100 mg / kg feed + heat stress | 1233.00 ± 1,414    |
| P2 : Complete feed + secang wood extract 300 mg/kg pakan + heat stress | 1233.20 ± 2,774    |

The results of data analysis using analysis of variance (ANOVA) showed that the feed additive of secang wood extract on the carcass weight of male rabbits was significantly different (p <0.05), between K + and K-, P1 and P2 there were significant differences, K - with P1 and P2 there was no significant difference, P1 and P2 had no significant difference. The lowest carcass weight result in this study was K +. Live weight of rabbits affects the percentage of carcass, rabbits that have a larger live weight can produce a large percentage of carcass as well [20]. Close relationship between livestock
growth and feed consumption. High feed consumption will result in an increase in protein which can lead to a body weight gain in rabbits. Factors that influence the growth of rabbits are age, amount of feed consumed, and crude fiber in feed. The factors that affect the digestibility of crude fiber are the fiber content in the feed, the composition of the crude fiber constituents and the activity of microorganisms [21].

Flavonoid compounds that function as antioxidants can increase mucus production in the villi which can maintain intestinal epithelial homeostasis, this results in increased digestion and absorption of food substance in the digestive tract [12]. Flavonoids are phenolic compounds that function as appetite enhancers [7]. Flavonoids play a role in the digestive process by increasing the permeability of cell walls in the intestine and increasing nutrient absorption [9,13,22].

4. Conclusion

Feed additive of secang wood extract (Caesalpinia sappan L.) at a dose of 100 mg / kg of feed can maintain the body weight and carcass weight of male rabbits (Cuniculus forma domestica) exposed to heat stress.

5. References

[1] Antonini A G and Cordiviola C 2010 Genetic improvement in meat rabbits (Oryctolagus cuniculus) BAG - J. Basic Appl. Genet. 21
[2] Zeferino C P, Komiyama C M, Fernandes S, Sartori J R, Teixeira P S S and Moura A S A M T 2013 Carcass and meat quality traits of rabbits under heat stress Animal 7 518–23
[3] Marai I F M, Habeeb A A M and Gad A E 2002 Rabbits’ productive, reproductive and physiological performance traits as affected by heat stress: A review Livest. Prod. Sci. 78 71–90
[4] Liu H W, Dong X F, Tong J M and Zhang Q 2011 A comparative study of growth performance and antioxidant status of rabbits when fed with or without chestnut tannins under high ambient temperature Anim. Feed Sci. Technol. 164 89–95
[5] Hassan F A, Mahrose K M and Basyony M M 2016 Effects of grape seed extract as a natural antioxidant on growth performance, carcass characteristics and antioxidant status of rabbits during heat stress Arch. Anim. Nutr. 70 141–54
[6] Khalifa A W H, El-Sisy G A, El-Nattat W S, Mourad A and Maghraby N 2018 Effect of water extract of dates palm (Phoenix dactylifera) on semen characteristics and oxidative stress in serum of male New Zealand rabbits under heat stress Asian Pacific J. Reprod. 7 22–6
[7] Badami S, Moorkoth S, Rai S R, Kannan E and Bhojraj S 2003 Antioxidant activity of Caesalpinia sappan heartwood Biol. Pharm. Bull. 26 1534–7
[8] Raj C D, Dhinesh M G, Lavanya R and Brindha P 2014 Studies on antiproliferative and antioxidant efficacy of caesalpinia sappan L. Heartwood Asian J. Chem. 26 3683–6
[9] Nirmal N P and Panichayupakaranant P 2015 Antioxidant, antibacterial, and anti-inflammatory activities of standardized brazilin-rich Caesalpinia sappan extract Pharm. Biol. 53 1339–43
[10] Chen F Z, Zhao Q, Yan J, Guo X Q, Song Q, Yao Q and Gou X J 2014 Antioxidant activity and antioxidant mechanism of brazilin and neoprotosappanin from caesalpinia sappan lignum Asian J. Chem. 26 4979–81
[11] Lee M J, Lee H S, Jung H J, Lee C S, Kim J E, Moon H I and Park W H 2010 Caesalpinia sappan L. ameliorates hypercholesterolemia in C57BL/6 mice and suppresses inflammatory responses in human umbilical vein endothelial cells (HUVECs) by antioxidant mechanism Immunopharmacol. Immunotoxicol. 32 671–9
[12] Lee M J, Lee H S, Kim H, Yi H S, Park S D, Moon H I and Park W H 2010 Antioxidant properties of benzylenhroman derivatives from Caesalpinia sappan L. against oxidative stress evaluated in vitro J. Enzyme Inhib. Med. Chem. 25 608–14
[13] Suwan T, Wanachantararak P, Khongkhunthian S and Okonogi S 2018 Antioxidant activity and potential of Caesalpinia sappan aqueous extract on synthesis of silver nanoparticles Drug Discov. Ther. 12 259–66

[14] Liang C H, Chan L P, Chou T H, Chiang F Y, Yen C M, Chen P J, Ding H Y and Lin R J 2013 Brazilein from caesalpinia sappan L. Antioxidant inhibits adipocyte differentiation and induces apoptosis through caspase-3 activity and anthelminthic activities against hymenolepis nana and anisakis simplex Evidence-based Complement. Altern. Med. 2013 1–14

[15] Hafsan H, Sukmawaty E, Masri M, Aziz I R and Wulandari S L 2018 Antioxidant activities of ethyl acetate extract of endophytic fungi from caesalpinia sappan L. and eucheuma sp Int. J. Pharm. Res. 10 239–44

[16] Safitri R, Tarigan P, Freisleben H J, Rumampuk R J and Murakami A 2003 Antioxidant activity in vitro of two aromatic compounds from Caesalpinia sappan L. BioFactors 19 71–7

[17] Liu H W, Dong X F, Tong J M and Zhang Q 2010 Alfalfa polysaccharides improve the growth performance and antioxidant status of heat-stressed rabbits Livest. Sci. 131 88–93

[18] Marshall V A, Johnson K J, Moore N P, Rasoupol R J, Tornesi B and Carney E W 2015 Comparative response of rat and rabbit conceptuses in vitro to inhibitors of histiotrophic nutrition Birth Defects Res. Part B - Dev. Reprod. Toxicol. 104 1–10

[19] Birolo M, Trocino A, Zuffellato A and Xiccato G 2016 Effect of feed restriction programs and slaughter age on digestive efficiency, growth performance and body composition of growing rabbits Anim. Feed Sci. Technol. 222 194–203

[20] Gidenne T, Combes S, Feugier A, Jehl N, Arveux P, Boisot P, Briens C, Corrent E, Fortune H, Montessuy S and Verdelhan S 2009 Feed restriction strategy in the growing rabbit. 2. Impact on digestive health, growth and carcass characteristics Animal 3 509–15

[21] García-Ruiz A I, García-Palomares J, García-Rebollar P, Chamorro S, Carabaño R and De Blas C 2006 Effect of protein source and enzyme supplementation on ileal protein digestibility and fattening performance in rabbits Spanish J. Agric. Res. 4 297–303

[22] Cha J Y, Kim H S, Moon H I and Cho Y S 2012 Erratum: Effect of betaine on the hepatic damage from orotic acid-induced fatty liver development in rats (Journal of Enzyme Inhibition and Medicinal Chemistry (2012) DOI: 10.3109/14756366.2011.641014) J. Enzyme Inhib. Med. Chem. 27 758

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