THE EFFECTS OF SELENIUM AND VITAMIN E INJECTION ON BODYWEIGHT LOSS AND PHYSIOLOGICAL STATUS OF TRANSPORTED CATTLE

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Abstract

This study aimed to determine the effect of injecting mineral selenium (Se) and vitamin E on body weight loss and physiological status (respiration rate and peripheral body temperature) of transported beef cattle. In total 28 Brahman Cross (BX) cattle with a body weight of 450 ± 30 kg with coefficient variation 8,65%. The experimental method was used in this study with Complete Randomized Design (CRD) with four treatments and repeated seven times. Treatments at the study were P1: Placebo Solution, P2: Injection Se 4 ppm, P3: Injection of vitamin E 36 ppm, and P4: Injection of Se 5 ppm + vitamin E 36 ppm. Duration of transportation from Subang to Tasikmalaya were six hours. Data were analysed was with analysis of variance and orthogonal test. No statistical differences were found regarding the administration of Se and vitamin E to the body weight and physiological status. This might be indications that: a) administration of Se, vitamin E and their combination can preserve the physiological function of the beef cattle after transportation in their normal state as before the transportation occurred; or b) no stress experienced by the animals during the transportation.

Key words:transportation, antioxidant, physiological status, beefcattle

INTRODUCTION

Beef cattle production is an important part of economic development and the adequacy of animal protein for the Indonesian people. According to the Director General of Livestock and Animal Health of the Ministry of Agriculture in 2017, the demand for beef and buffalo in Indonesia reached 546 thousand tons. Until now, the fulfillment of domestic beef cannot be met by local farmers, therefore the government has imported livestock and beef to meet the national meat needs. Furthermore, to fulfill this demand, beef cattle need to be distributed to every part of Indonesia, by transportation.

Transportation is an important aspect in the livestock marketing system. Transportation activities such as preparation for transportation, loading, transportation and unloading of livestock carried out by livestock entrepreneurs using trucks or other transportation generally can cause stress(Bulitta et al., 2015). Furthermore, it is explained that several main factors causing stress on livestock during transportation are microclimate characteristics or meteorological factors (temperature, humidity, wind speed and solar radiation) and non-meteorological factors (handling of livestock during loading/unloading, length of voyage/trip, vibration, design of livestock transport vehicle, livestock density within transport vehicle, quantity and quality of feed provided and availability of drinking water).

Provision of minerals, such as selenium (Se) and vitamin E is one of the efforts to reduce the impact of stress on the body of livestock. Se and vitamin E function as antioxidants that have different roles to reduce stress. Previous studies have shown that administration of Se and vitamin E can reduce stress in newborn calves (Mehdi & Dufrasne, 2016), thereby reducing body

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weight loss and minimizing disturbances in physiologic status.

Se functions to increase the body's immune response and as an antioxidant for components/materials forming the enzyme Glutathione Peroxidase (GSH-Px)(Pilarczyk et al., 2012). Vitamin E is a natural antioxidant, which plays a role in maintaining optimal performance and production and can maintain immune function(Ghaffari et al., 2019). The role of Se and vitamin E cannot be separated to reduce stress in livestock, because Se and vitamin E have different but related roles to maintain body stability so that the livestock body does not experience stress. Vitamin E works to prevent the formation of free peroxides, while Se works to reduce peroxides that have already been formed(Fellenberg & Speisky, 2006).

MATERIALS AND METHODS

Animals, Transportation, and Experimental Design

The livestock used were 28 Brahman Cross (BX) beef cattle with a body weight of 450 ± 30 kg with a coefficient of variation of 8.65%. livestock transported from PT. Agrisatwa Jaya Kencana in Subang, West Java, Indonesia and transported to PT. Lintas Nusa Pratama in Tasikmalaya, West Java, Indonesia for 6 hours drive.Each 7 cattle were allocated to 1 of 4 treatments, namely: P1: Placebo solution (control); P2: 110 ppm Se injection; P3: 36 ppm vitamin injection; P4: Injection of Se 110 ppm + vitamin 36 ppm.Therefore, the experimental design comprises of 4 treatments with 7 replications.

Treatments and Injections

The minerals (Se and vitamin E) were purchased from PT Brataco, Bandung, Indonesia in the form of powder. The minerals then weighed as the treatment specifications using an analytical balance then mixing the mineral Se with physiological NaCl, vitamin E is dissolved using glycerol and a mixture of minerals Se and vitamin E with physiological NaCl and glycerol then inserted into the syringe according to a dose of 3 ml for each cow. Prior to the transportation, the cattle in PT Agrisatwa Jaya Kencana in Subang, West Java, Indonesia were injected intramuscularly with mineral Se and vitamin E intramuscularly according to the treatment specifications on the back and then body-weighed using a capacity of 1500 kg scale with the tolerance of 500 grams. After weighing, the measurement of physiological status was done, then the beef cattle transported using cattle trucks to be sent to PT. Lintas Nusa Pratama,Tasikmalaya, West Java, Indonesia for a distance approximately 190 km in the time of approximately 6 hours. after arriving at PT. Lintas Nusa Pratama re-weighed the cattle and measured the physiology status at the cattle crush.

Data collection

Data collection was carried out at two time points, namely at PT. Agrisatwa Jaya Kencana in the morning at 09.00 am before the transportation of beef cattle and at PT. Lintas Nusa Pratama in the afternoon after the transportation of beef cattle at 05.00 pm. The data taken are bodyweight (BW) data and physiologic status. The bodyweight data was treated as the basis of bodyweight shrinkage calculation, which calculated using this equation:

$$\text{Bodyweight shrinkage (\%)} = \frac{BW\ before\ transport - BW\ after\ transport}{BW\ before\ transport}\ x\ 100\%$$

Physiological status which measured includes respiration frequency, heart rate, and body temperature. The respiration frequency in cattle is done by bringing the back of the hand to the nose of the cattle, so that the breath will be felt. The treatment was carried out for 1 minute 3 times and then the average was calculated. At the time of the study the measurement of respiratory frequency seen from the movement of the abdomen, the treatment was carried out for 1 minute 3 times and then the average was calculated. Heart rate in cattle is done by feeling the base of the tail so that the caudalis artery pulse can be felt. The treatment was carried out for 1 minute 3 times and then the average was calculated. Body temperature is measured by using an industrial-class infra-red thermometer (IRTek IR60i, Australia), by pointing it to head and the center of the body. Due to the technical difficulties to measure the rectal temperature, the peripheral body temperatures were measured.Peripheral body temperature measurement was carried out using an infrared thermometer that was utilized at two parts, namely the head and body.

Statistical Analyses

In order to determine the response to the treatment given, the data obtained were tested using analysis of variance, with the following model:

$$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$$

Description: Y_{ij} : The observation value of the j-th test that received the -i-th treatment.

μ : General means.

τ_i:Effect of i-th treatment

ε_{ij}: The effect of errors (errors) that arise in the j-th test that gets the i-th treatment.

i : i-th treatment.

j : j-th replication.

Data were statistically analyzed with analysis of variance (ANOVA) to detect the effects of treatments, using PROC GLM in SAS Statistics 9.2 (SAS Institute Inc., 2008). Values in the results section are presented as least square means (LSMeans) with their pooled standard error of means (SEM). All effects were considered significant at the level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

Overview of experimental conditions

This study on beef cattle transportation begins with the cattle selection process at PT Agrisatwa Jaya Kencana Subang. The selection process starts at 08.00 am by PT Lintas Nusa Pratama officers based on body weight, after the selection process is carried out then the cows are herded to a weighing station which is ± 5 m from the cattle pen. After the cows are weighed and recorded, the cows are brought back to the cattle crush, which is ± 30 m from the weighing station, the cows are checked for physiological status (respiratory frequency and peripheral body temperature (head and body)) and a blood sample is taken at the base of the tail and then given injection according to the treatment in the shoulder. Heart rate cannot be measured because cows are difficult to control even in cattle crush. Cows that have been calculated for physiological status and given injections are put into cages according to vehicle placement. The required duration from the selection process to before being transported is ± 2 hours.

Livestock began to be transported at 10.00 am from PT Agrisatwa Jaya Kencana to PT Lintas Nusa Pratama. The duration of the journey taken in this study was 6 hours 48 minutes, with smooth travel conditions with the intensity of congestion at certain points (Rancaekek, Bandung, West Java, Indonesia). The driver's driving means in the two vehicles was not different, the normal speed is around 40-65 km/hour. The weather at the time of transportation in this study was sunny with temperatures in each region, namely Subang 27°C, Bandung 27°C, Garut 30°C and Tasikmalaya 27°C. The condition of the roads that are slightly potholes in the area outside the Subang farm and the road conditions from Bandung to Tasikmalaya are asphalt, with the asphalt condition not being too smooth due to the large number of asphalt patches in the Bandung and Garut areas which make livestock experience shocks during the transportation process.

At 4.45 pm, the vehicles arrived together at the PT Lintas Nusa Pratama in Tasikmalaya, West Java, Indonesia. The cattle started to be unloaded from the vehicle at 5.00 pm, the livestock reduction was carried out in stages, namely by first unloading 14 cattle from one truck, the cattle were unloaded and placed in the cage gangway to measure physiology status and take blood samples. To facilitate the measurement of physiology status and blood sampling, the livestock is compacted in the gangway of the cage, after the process of measuring the physiological status of the livestock is carried out, it is directed to the scales to re-weigh the process and then put it in the cage. The same process was carried out on the next 14 cattle. The process takes ± 2 hours.

Effect of Treatment on Weight Loss

Body weight loss is an indicator of the high and low levels of stress due to transportation. The average body weight loss of each treatment can be seen in table 1.

Table1 Effect of Treatment on Weight Loss (%)

Replication	Treatment			
	P1	P2	P3	P4
1	2.92	2.76	2.60	2.79
2	2.42	2.95	2.39	2.72
3	2.50	2.28	2.77	2.96
4	2.34	2.64	2.60	2.80
5	2.53	2.77	2.39	2.73
6	2.82	2.79	2.77	2.51
7	2.85	7.15	2.28	2.76
Total	18.38	23.35	17.80	19.27
Average	2.63	3.34	2.54	2.75

Description: P1: Placebo solution.
P2: Se Injection
P3: Vitamin E injection.
P4: Injection of Se + vitamin E

Based on Table 1. it can be seen that the body weight loss in various treatments was quite varied. The average weight loss obtained from the lowest to the highest is P1(6.69%), P3(6.70%), P2(7.31%) and P4(7.59%). Body weight loss in the study ranged from 6.69% to 7.59% with a transportation time of 6-7 hours of travel. The results of this study showed very different results from the body weight loss studied byCandradinata (2014) that transportation for 5-6 hours caused weight loss of 3.69 ± 1.24%. Added byTanuwiria et al. (2011) stated that stress on beef cattle transported for 7 hours resulted in a decrease in body weight of 5.41%. The results of analysis of variance showed that the administration of a combination of injection, Se, vitamin E and their combination was not significantly different (P>0.05) on the percentage of body weight loss of transported cattle. This is presumably due to livestock experiencing high stress from handling before transportation, travel conditions to transportation (loading and unloading) so that livestock cannot maintain body homeostasis and result in a high body weight loss.

Many factors cause livestock to experience stress, namely the handling of livestock from selection, weighing, during treatment, to the reduction of livestock from vehicles(Alam et al., 2018). Livestock must adapt to the new environment, withstand shocks during transportation, poor roads such as potholes and asphalt fillings. In previous studies, it was stated that the main cause of decreased body weight of livestock is stress factors, one of which is fatigue or excessive movement where the longer the journey or transportation of livestock, automatically the number of movements will be greater and the level of fatigue will be even greater(Alam et al., 2018; Earley et al., 2017; Fazio et al., 2015; González et al., 2012). In addition, body weight loss can be caused by a loss of fluid in the body and muscles of livestock(González et al., 2012).

The unsignificant results between treatments indicated that injection of Se, vitamin E and their combination was not able to minimize the effects of stress experienced by livestock from before being transported to after being transported. This is not in line with previous research which stated that the synergistic combination of vitamin E and Se was able to reduce the negative effects caused by stress, including stress due to transportation(Aktas et al., 2011). Vitamin E, Se and their combination function to protect tissues from oxidative damage and can increase the body's immune response(Dimri et al., 2010; do Reo Leal et al., 2010; Liu et al., 2016).

Effect of Treatment on Physiological Status

Physiological status (respiratory frequency and body temperature) is one of the physiological indicators of high and low levels of stress due to transportation. The average physiologic status of each treatment can be seen in table 2.

Table 2 Effect of Treatment on Respiratory Frequency Before and After Transportation

Parameter	Treatment	Before Transportation (Subang)	After Transportation (Tasikmalaya)
		.......................times/minute...................	
Respiratory frequency	P1	43	40
	P2	42	41
	P3	43	44
	P4	45	39

Description: P1: Placebo solution
P2: Se Injection
P3: Vitamin E injection
P4: Injection of Se + vitamin E

Based on Table 2, it can be seen that the average respiratory frequency from the lowest to the highest is P1 (43 times/minute), P2 (42 times/minute), P3 (43 times/minute) and P4 (45 times/minute), while the normal respiration in beef cattle is about 34 times/minute(Salles et al., 2016). This shows that the respiratory frequency in cattle before being transported is higher compared to the normal respiratory rate. Handling cattle before being transported is long enough to increase stress and respiratory rate. The cows are herded to the cattle crush where the treatment is too far away causing the cattle to experience stress before the measurement is carried out. According toGrandin (2007), one of the consequences of stress is excessive movement. This shows that the higher the heat load received and the less good handling before, during and after transportation activities cause the livestock to experience stress, so that the cow increases the dissipation of body heat through breathing by increasing the frequency of breathing.

The respiratory frequency in cattle that have been transported has decreased even though it is still not close to the normal respiratory frequency of beef cattle, the number of respiratory frequencies after being transported is P1 (40 times/minute), P2 (41 times/minute), P3 (44 times/minute).) and P4(39 times/min),while the normal respiration in beef cattle is about 34 times/minute(Salles et al., 2016). This shows that the respiratory frequency in cattle after being transported is higher compared to the normal respiratory rate. The results of analysis of variance showed that the administration of a combination of injection of Se, vitamin E and their combination was not significantly different ($P>0.05$) on the respiratory frequency of transported cattle. This is presumably due to livestock experiencing high stress from handling before transportation, travel conditions to transportation (loading and unloading) so that livestock cannot maintain body homeostasis and result in abnormal respiratory rates.

The effect of treatment on body temperature before and after transportation is presented in Table 3. Based on Table 3, it can be seen that the head and body temperatures experienced a decrease. According to Reece et al. (2015)that the normal range of body temperature in mammals is 38-39.3ºC.

Table 3 Effect of Treatment on Peripheral Body Temperature Before and After Transportation

Parameter	Treatment	Before Transportation (Subang)	After Transportation (Tasikmalaya)
		..........................ºC.............................	
Head temperature	P1	32.29	29.29
	P2	33.29	29.43
	P3	31.71	28.43
	P4	32.86	30.00
Body temperature	P1	32.14	29.86
	P2	32.71	30.86
	P3	32.14	30.00
	P4	32.00	30.86

Description: P1: Placebo solution.
P2: Se Injection
P3: Vitamin E injection.
P4: Injection of Se + vitamin E

Body temperature after transportation has decreased. This decrease might be due to the low ambient temperature and high wind velocity during transport. Moreover, the measured body temperatures were at the peripheral points (e.g., head and body), which is lower than the core body temperature (Godyń et al., 2019). The results of analysis of variance showed that the administration of a combination of injection of Se, vitamin E and their combination was not significantly different (P>0.05). This shows that the provision of treatment cannot minimize or cannot maintain the physiological status (peripheral body temperatures) of cattle due to heat stress caused by an imbalance between the amount of heat produced and the amount of heat released by the body into the environment.

CONCLUSION

No statistical differences were found regarding the administration of Se and vitamin E to the body weight and physiological status. This might be indications that: a) administration of Se, vitamin E and their combination can preserve the physiological function of the beef cattle after transportation in their normal state as before the transportation occurred; or b) no stress experienced by the animals during the transportation.Hence, there might be a potential of this minerals to alleviate transport stress, maybe with a higher dose. Further research needs to address the proper dose and stress-related blood and hormonal parameters in higher intensity of stressors during transportation.

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