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UTILIZATION OF COCONUT WATER-BASED ELECTROLYTE SOLUTION AND ROSELLE EXTRACT ON BODY WEIGHT AND PHYSIOLOGICAL RESPONSES ON PADJADJARAN RAM

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Abstract
Animal transportation usually causes a weight loss. This surely becomes an economical loss. Animal suspected to be under stress circumstances during the transportation which caused physiological change. Twenty Padjadjaran rams which have average weight between 17 – 26 kg were used in this research. Research was done experimentally using Completely Randomize Design with four levels of electrolyte solution treatment which are P1 (0 mL), P2 (75 mL), P3 (12.5 mL), and P4 (150 mL). Every treatment was added by 25 mg of Roselle extract and replicated five times. Rams were transported for 8 hour using pick-up car with capacity of 20 rams. Observed variables were body weight, and physiological responses which consist of rectal temperature, respiration rate, heart rate, glucose level and blood's urea. The observation showed that body weight was not significantly different (P>0.05) between treatments. The respiratory rate and heart rate also resulted not significant (P>0.05), although it can be tolerated because rectal temperature was in a normal range. Values of glucose and blood's urea decreased although it were still not significantly different (P>0.5). In conclusion, the utilization of coconut water-based electrolyte solution with roselle extracts addition can suppress body weight loss without gives any major effect physiologically to the Padjadjaran ram.

Key words*: electrolyte, coconut water, roselle, transportation, Padjadjaran ram.*

INTRODUCTION

Transportation plays an important part in Farm animal to ensure the distribution of both livestock and its production. Transportation can improve mobility of the livestock but it also can be a potential source of physiological disruption. Livestock is not fed and watered during transportation, meanwhile there are stressors that arise that need to be taken care immediately (Knowles and Warriss, 2000). To overcome this condition, additional energy is needed to perform homeostasis process (Campbell, 2010) that will result in body weight decrease around 8-10% after transportation (Cockram, 2007).

Stressors during transportation will cause physiological stress such as thirst, hunger or psychological stress such as fear, restlessness. It can be happen because of separation from the bigger herd, bump, physical bump and environmental stress such as climate, weather, feed, noise and human presence (Minka and Ayo, 2012). Physiological reactions during transportation are very dynamic, especially in heat release in form of evaporation such as sweat excretion, excessive salivation, heart rate increase, respiration and panting (Bernardini, 2012). It will cause body fluid and electrolyte become unbalance if it occurs during long period of time because half of fluid either from extracellular or intracellular fluid and important electrolyte will be excreted from body (Knowles and Warriss, 2000). Body fluid and electrolyte that are excreted from body will immediately overcome by administration of isotonic fluid instead of water (Koswara, 2009).

Coconut water (*Cocos nucifera*) is one of natural liquid that isotonic with body fluid and equipped with energy resources, vitamins and minerals. Meanwhile roselle is herbs that contain high ascorbic acid and active compounds such as flavonoids and polyphenols that act as secondary anti-oxidant (Ramirez-Rodrigues et al., 2011). These two materials can be utilize as ready to use electrolyte source to supress oxidant or free radical to prevent reactive characteristic of oxidant (Pokorný, 2007).

The objective of this research is to understand effect of utilization of coconut water based electrolyte and roselle extract on Padjadjaran rams body weight and physiological condition.

MATERIALS AND METHODS

Twenty Padjadjaran rams with body weight between 17 – 26 kg and age between 1 – 1.5 years old were transported for 8 hours withoutt a rest. Research was done experimentally with Completely Randomize Design (CRD) that consist of 4 treatments that each repeated 5 times. Mineral contents of coconut water and roselle extract were used to design the treatment formula can be seen in Table 1.

Table 1. Coconut Water (*Cocosnucifera*) and Roselle Extract (*Hibiscus sabdarifa*) Contents in Treatment

Material	Concentration
Coconut Water[a]	
Sodium (mg/L)	105
Potassium (mg/L)	312
Chlorine (mg/L)	183
Roselle Extract	
Vitamin C (mg/100g)[b]	250.75
Flavonoid (mg/L)[c]	29.74
Phenol Total (mg/L)[c]	292.01

Source :[a] Young (2009) ; [b]Lab. Penelitian dan Pelayanan UNPAD (2014) ; [c] Ramirez-Rodrigues (2011)

Rams were given treatment formula before transportation and not allowed to be fed and watered during it. Content of the treatment formula can be seen in Table 2. A pick-up truck with capacity of 20 rams was used during transportation. Rams were weighed, measured its physiological status and taken its blood sample before and after the transportation. Each rams was given a mark to make observation easier.

Measurement methods:

1. Body weight was measured using scale with capacity of 100 kg with deviation of 0.1 kg.
2. Physiological status such as heart rate, respiration rate, and rectal temperature were measured using stethoscope and counter. Heart rate measured by counting heart rate for 1 minute. Respiration rate measured by counting inspiratory and expiratory for 1 minute. Meanwhile rectal temperature measured by inserting clinical thermometer to rectum for 3 minutes.
3. Blood samples were taken as much as 3 mL using syringe. Then it was stored in vacuum tube EDTA and cold temperature to prevent coagulation before it was analyzed. Blood samples were used to determined glucose level and blood urea. Measurement was done by Haematology analyzer in a commercial laboratory named Multitest in Bandung.

Table 2. Content of Coconut Water and Roselle Extract Based Electrolyte Solution for Each Treatment

Electrolyte Solution Formulation	Treatment			
	P0	P1	P2	P3
Coconut Water (mL)	0	50	75	100
Sucrose (g)	0	4,5	6,75	9
Sodium Chloride (g)	0	0,5	0,75	1
Sodium Benzoate (g)	0	0,1	0,15	0,2
Potash (g)	0	3,1	4,65	6,2
Citric Acid (g)	0	0,1	0,15	0,2
Vit.C in Roselle Extract(mg)	0	25	25	25
Distilled Water	75	75	112,5	150

RESULTS AND DISCUSSIONS

Live Body Weight

Administration of coconut water-based electrolyte and roselle extract showed change in body weight with range from 0 – 5.47%. Statistical analysis showed that the change in body weight between treatments was not significantly different. It has to be noted that control treatment (P0) had the highest body weight loss. Meanwhile there were not any body weight loss for treatment P1 and P2, and 2.38% for treatment P3 (Figure 1).

Dehydration often happen in transported livestock and it is usually considered as cause of weight loss (Benardini, 2012).In dehydration state there will be a exchange of water and electrolyte from intracellular and interstitial to intravascular (Cockram, 2007). That fluid exchange depends on tonicity and hidrostatic pressure of remaining extracellular fluid. It will also affect dehydration degree of organs (Schaefer et al.,1997). Administration of

coconut water-based electrolyte and roselle extract before transportation is a form of prevention toward dehydration. Coconut water-based electrolyte and roselle extract formulated to replace lost electrolyte. Coconut water is a fluid that istonic with blood fluid and Its contain compunds such as sodium bicarbonate, sodium sitrat, potash (Koswara, 2009).

This research showed that treatment P0 experienced highest weight loss compare to other treatments. This allegedly occurred because rams in treatment P0 were only given distilled water (aquades) before transportation so that the rams did not have electrolyte supply to replace what was lost. Unlike treatment P0, other treatments were given coconut water before transportation. Coconut water that

Table 3. Effect Of Coconut Water-Based Electrolyte Solution and Rosella Extract on Body Weight And Physiological Responses on Padjadjaran Ram

Parameter	Treatment							
	P0		P1		P2		P3	
	1	2	1	2	1	2	1	2
Body Weight (kg)	20.48 ± 2.65	19.36 ± 2.74	21 ± 0.62	21,08 ± 0,73	22.16 ± 3.26	22.16 ± 3.54	21.88 ± 3.75	21.36 ± 3.84
Heart Rate (Freq/minute)	81 ± 16.16	73 ± 33.38	65 ± 8.82	62 ± 5	62 ± 3.88	63 ± 4.47	79 ± 22.75	63 ± 7.29
Respiration rate (Freq/minute)	42 ± 4.17	45 ± 8.06	37 ± 3.42	45 ± 6.95	39 ± 6.20	42 ± 4.35	45 ± 17.05	40 ± 9.05
Rektal temperature (°C)	39.8 ± 0.1	39.7 ± 0.28	39.7 ± 0.19	39.34 ± 0.15	39.78 ± 0.08	39.68 ± 0.24	39.98 ± 0.24	39.7 ± 0.19
Blood glucose (mg/dL)	49.2 ± 10.43	37.46 ± 22.82	71.60 ± 36.80	28.60 ± 7.44	54.33 ± 11.78	27.40 ± 6.58	73.60 ± 28	52.2 ± 29.72
Blood urea (mg/dL)	40.94 ± 14.81	33.50 ± 2.93	42.08 ± 13.93	34.08 ± 2.61	41. 68 ± 14.19	33.42 ± 1.41	45.42 ± 13.06	35.30 ± 3.33

1:before transportation; 2: after transportation

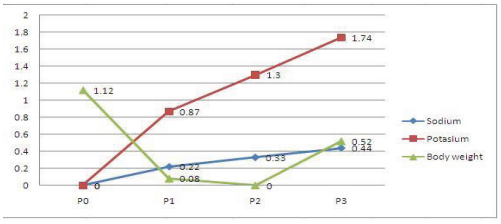

Figure 1. Body Weight Change after transportation

Observation indicate that addition of coconut water-based electrolyte and roselle extract tend to suppress the body weight loss in 8 hours of transportation process. The given treatment alledgedly replace lost electrolyte immediatly along with urine, feces or sweat (Bernandini, 2012; Gortel et al., 1992, cited by Schaefer et al., 1997). This will make pool size water space in interstitial undisturbed, (Gortel et al., 1992, cited by Schaefer et al., 1997). On the other hand, livestock will experience stressor along transportation which can affect physiological and biological process in their body. Heat levelling and metabolism increase caused by increase of cortisol concentration in fight and flight have to be provided by additional energy, (Campbell, 2010).

contains electrolyte (Na and K) and sucrose that can be used as energy source.It also contains vitamin C as anti-oxidant.

The non significant result of weight loss parameter is in line with Hobson (1997) statement, especially in rams which prioritize sufficient of water better than electrolyte condition. Administration of electrolyte intended to improve livestock's performance (Schaefer, 1997), meanwhile roselle extract contains vitamin C that can suppress free radical that often happen during transportation (Minka and Ayo, 2012). Another reason of non significant result is that treatment P0 were given distilled water equivalent to treatment P1 so that these two treatments have different amount of nutrient and electrolyte in water coconut-based electrolyte and roselle extract. Because of that reasons, it is strongly possible that result of treatment P1 and P2 are contributed from coconut water-based electrolyte and roselle extract although the weight loss still not significant.

In this research, body weight loss percentage range after 8 hours of transportation is lower than observation result of Purnomoadi et al 2003 in Endang Purbowati et al. (2005) that range about 1.0 – 1.2 kg or equal to 7.1 – 8.2%.

Heart Rate, Respiration Rate and Rectal Temperature

Data about heart rate, respiration rate, and rectal temperature can be seen at Table 3. Heart rate after transportation was decreased in treatment P0 (9,88%), P1 (3,08%) and P3 (20,25%), meanwhile it was increased in treatment P2 (1.61%). Respiration rate was increased for treatment P0 (6%), P1 (21.9%), P2 (10.4%), meanwhile it was decreasing in treatment P3 (6.9%). For rectal temperature, all of treatment were decreased as in 10.9% for P0, 3.6% for P1, 0.7% for P2, and 16.4% for P3. Statictical analysis showed that addition of coconut water-based electrolyte and roselle extract was not significantly different ($P > 0.05$) for those 3 parameters. This can be interpreted that eventhough a change occured between after and before the transportation, it did not cause significant difference physiologically.

The result of observation from this research were opposite from others previous research where almost every transportation could increase heart rate, respiration rate and body temperature (Lefcourt et al., 1986, cited by Kassab, 2014). This contradiction was alledgedly happen in this research because those parameters were higher before transportation condition than after transportation condition as result of handling. Every stressor from internal or external that experience by livestock is a stimulus that will be responded immediatly by system neuroendocrin through sympatho-adrenal-medullary (SAM) axis. SAM axis is a short term respond system that very effective to solve problem (Griffin, 1989, cited by Parker, 2004). It will be secreted by catecholamine from adrenal medulla and functioned to improve vigilance (fight and flight). An increase in heart rate and dilation of blood vessel are parts of homeostasis process. The objective of heart rate increase is to accelerate blood pumping to cells throughout body. Meanwhile blood vessel dilation has purpose to release heat out of body through sweat, however rams have a more effective system to do it by evaporation or an increase in respiration rate (Knowles and Warriss, 2000).

Respiration is a form of respond from livestock to release or replace heat with surrounding heat, (Yani, 2006). An increase of blood temperature by 1^0C will activate heat receptor on peripheral and hypothalamic (Bouchma and Knochel, 2002, cited by Sugito, 2009). In the end, all of this process inside body will be manifested in body temperature. Body temperature in homeotherm animal have to remain constant, therefore it has to be arrange by balancing heat loss and heat gain inside body (Yousef, 1985). If livestock cannot lose heat form inside the body, it will cause organs temperature to increase. If this situation happen in long term periode, it will be handled by glucocorticoid, a hormone secreted by the adrenal cortex on stimulation from corticotropic realising hormone (CRH) and adenocorticotropic hormone (ACTH). Analogically, the more higher concentration of glucocorticoid especially cortisol in blood the more higher stress experience by livestock (Bernardini, 2014), Because of that reason a decrease in cortisol level in blood can be interpretated as a sign that homeostatis process have been completed.

In this research, decrease in heart rate and respiration rate happened in mid and end of transportation, meanwhile body temperature would back to normal. The heart rate recorded in a range of 62-83 freq/minute which is considered normal at 60–80 frequency/minute (Smithand Mangkoewidjoio, 1988). Respiration rate recorded in a range of 37-45 frq/minute which higher than normal average by Frandson (1996) at 19 frequency/minute. The high respiration rate is a homeostatis mechanism in order to maintain body temperature. This condition can be seen from average body temperature about 39.7-39.9^{o}C which is still within a normal average about 39.2–40^{0}C (Smith and Mangkoewidjojo, 1988). Rectal temperature for rams as homoioterm animals are about 0.6–1.0^{0}C. Capability of endoterm animals to maintain its body temperature is an autonomic process from heat production. Those temperature will protect enzymates process inside the body from interruption (Roberto and Michael, 1992).

Based electrolyte solution is believed to be part of omoreseptor (Soeharsono, 2010), who helped oversee and control systems of the body fluids, electrolytes such as sodium and potassium and other ions play a role in regulating traffic nutrients into the cell. Similarly, the role of roselle extracts as

antioxidants, ie vitamin C, flavonoids inhibit free radicals formed when phosphorylation in the mitochondria (Ramirez-Rodriguez, 2011).

The mean rectal temperature of sheep after treatment showed lower transport before the transport. This is allegedly closely related to system heat setting, the heat for the animals homeoterm sourced from heat metabolism, but also influenced by the external environment, including temperature, humidity, radiant sun and wind movement (Cockram, 2007; Yani, 2006). During the 8 hour trip, sheep in the fasting state of eating and drinking while the first 4 hours ambient temperature of transportation reached the peak is 32^{o}C. The condition affects the physiological functions of the body, but the four-hour journey end relative ambient temperature dropped to 22.7^{o}C (cool). Heat exchange occurs between the body of livestock and the environment is relatively easy so it does not require additional energy for the process of homeostasis.

Body temperature in the range - therefore in his body control system equipped with a highly sensitive and receptor systems (osmoreceptors and baroreceptors) (Raharja, 2010). Both systems actively work related to the changes that occur during the transport takes place. Barriers process heat release in sheep often occurs because almost the entire body covered in fur, so that evaporation is considered more effective way. Sheep known as the panting animal, while releasing heat from its body can be done in several ways, one of which is the mechanism of evaporation. Evaporation is an effective way to eliminate body heat load, every gram of moisture evaporation will eliminate body heat calorie 0.582 (Yousef, 1985). Air humidity can be used to control evaporation heat loss livestock from the skin and respiratory system. High humidity can cause evaporative heat loss of livestock hampered.

Blood Glucose and Blood Urea

Energy needed during transportation depends on stressor level that experienced by livestock so that glucose level in blood as precursor have to be maintained in a relatively satble condition. Glucose always have to be available in body because of its function as primary precursor energy for metabolism. Glicogen is first choice followed by fat and protein in reserved energy.

From observation, glucose level of rams before transportation are about 49.2 – 73.6 mg/dL, but after 8 hour of transportation it decreased. Treatment P1 have the highest decrease with 43 mg/dL or 60.06%. Treatment P2 and P3 decreased by 26.30 mg/dL (49.57%) and 21.4 mg/dL (23.86%), meanwhile treatment P0 decreased by 11.74 mg/dL (23.86%). This condition showed that glucose level tend to decrease along with incrase of coconut water-based electrolyte and roselle extract dosage.

Glucose is a nutrient that can be immediately convert to be energy source. Normal ram has glucose level of 35 – 60 mg/dL (Riis et al, 1983). Glucose level of Padjadjaram rams that were given coconut water-based electrolyte and roselle extract before transportation in Padjadjaran rams is not significantly different ($P > 0.05$). It showed that eventhough there is a difference in glucose level between before and after transportation, but it did not give any physiological meaning.

Decreased glucose level in treatment P1 alledgedly happen bacause the dosage of treatment solution given. Treatment P1 was given 75 mL of treatment solution that means almost all of glucose that available used for homeostatic process. Meanwhile treatment P2 and P3 were given 112.5 mL and 150 mL of treatment solution that means there is more glucose available. That condition made the decrease in treatment P2 and P3 lower than P1.

Sucrose in treatment solution is function as energy source. Sucrose is a non-reducing disaccharide that have α-ß-glycosidic bond. To break the bond of sucrose into glucose and fructose takes specific enzymes (Syahrir, 2011) which may lack in rumen's fluid of treatment's rams. Therefore only part of sucrose is used as energy source by rumen's microbe in intestine. Glucose enters blood sirculation ang use as precursor energy in cellular metabolism. It is strongly possible that during 8 hour of transportation, rams in treatment only used glucose from sucrose that contained in treatment solution and were not used glicogen.

Nitrogen in blood urea is an indicator to identified protein metabolism. Low level of blood urea indicate process of protein saving meanwhile high level of blood urea indicate catabolism process, (Peel et al 1981 in Isdoni 1996). Observation showed that there is a

decrease in blood urealevel from before and after transportation respectively 7.44 mg/dL (18.17%) for P0, 8 mg/dL (19.01%) for P1, 8.26 (19.82%) for P2 and 10.12 (22.28%) for P3. It showed that the more higher dosage of treatment solution given the more ureablood level decrease. This condition means that during transportation there were not any mass protein splitting because blood urea was decrease.

Statistical analysis showed that administration of coconut water-based and roselle extract is not significantly different ($P > 0.05$) between treatment. There was not shortage of energy in every treatment so that there was not any mass protein splitting either. Blood urea from every treatment is relatively the same around 33.42-35.30 mg/dL. Those number are considered a normal state which is between 15.0-36.0 mg/dL (Bendryman et al., 2000).

CONCLUSIONS

Administration of coconut water-based electrolyte and roselle extract before transportation do not give negative physiological responses, but there is a tendency of body weight loss supression without significant effect to heart rate, respiration rate, rectal temperature, glucose level and blood urea.

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