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EVALUATION ON PHYSIOLOGICAL RESPONSES OF WORKING BALI CATTLE

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ABSTRACT

Indonesia is an agriculture country where farmers still use their animal labour i.e. cows or buffalos to work in wet or dry field. In general, Bali cattle is a draught animal in producing food. It was selected as a strategic animal to fulfil the requirement of labour in those fields. But, effects of work on the animal physiology have not been much published yet. Therefore, in this opportunity an experiment was conducted to study physiological responses of working Bali cattle which being worked (2 hr). The objectives of the experiment were to study physiological responses of the animal i.e. rectal and skin temperatures, respiration rate, heart beat, erythrocytes, leucocytes, hemoglobine (Hb) and Packed Cells Volume (PCV) of the animals which being worked. Three pairs (6) female Bali cattle with body weight ranges between 255 - 268 kg per head were used in this experiment. The experiment was held for 2 months at Negara, Bali. Measurement was conducted before and soon after work (2 hr) on rectal and skin temperatures (°C) with a digital thermometer, respiration rate (per minute) with counting the inspiration and expiration of the air through the animals' nose, and heart beat (per minute) with stethoscope. Total number of erythrocytes and leucocytes were counted with hemacytometer, while Hb concentration with hemometer Sahli, and PCV with IEC MB centrifuge. Results of the experiment showed that physiological responses of working female Bali cattle (2 hr) as follows: 1). Rectal and skin temperatures increased significantly. 2). Respiration rate and were heart beat rose up highly significantly. 3). Hematology values of the animals were not significantly different from to the animals that did not work.

(Key Words: Bali Cattle, Rectal Temperature, Skin Temperature, Respiration Rate, Heart Beat, Erythrocytes, Leucocytes, Hemoglobine (Hb), and Packed Cells Volume). (PCV).

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EVALUASI RESPONS FISIOLOGI SAPI BALI YANG DIKERJAKAN

INTISARI

Indonesia adalah sebuah negara agraris dimana petani dalam pengolahan tanahnya (basah maupun kering) masih banyak menggunakan tenaga kerja yang berasal dari ternak baik sapi maupun kerbau. Secara umum sapi Bali merupakan salah satu ternak strategis yang terpilih secara nasional antara lain untuk memenuhi tenaga pengolah lahan pertanian. Namun efek kerja ini agar fisiologi ternak tidak terganggu belum banyak terungkap. Maka dari itu, pada kesempatan ini penelitian tentang respons fisiologi sapi Bali yang dikerjakan (2 jam) akan dievaluasi. Tujuan penelitian ini adalah untuk mempelajari respons fisiologi antara lain suhu rektal, suhu kulit, laju respirasi, denyut jantung, sel-sel darah merah, sel-sel darah putih, hemoglobi (Hb), bagian padat dari darah (PCV) ternak yang dikerjakan tersebut. Sebanyak 3 pasang (6 ekor) sapi Bali betina dewasa dengan berat badan berkisar antara 255 - 268 kg/ekor telah digunakan dalam penelitian ini. Penelitian ini berlangsung selama 2 bulan di Negara, Bali. Pengukuran suhu rektal dan kulit (°C) dilakukan dengan menggunakan sebuah termometer digital , laju respirasi (per menit) dengan menghitung keluar - masuknya udara pernapasan melalui hidung ,dan denyut jantung (per menit) dengan stetoskop, sel-sel darah merah dan darah putih dihitung dengan hemocytometer, hemoglobin (Hb) dengan hemometer Sahli, dan Packed Cells Volume (PCV) dengan IEC MB centrifuge telah dilakukan sebelum dan sesaat sesudah ternak dikerjakan. Hasil penelitian menunjukkan bahwa respons fisiologi sapi Bali yang dikerjakan (2 jam) adalah sebagai berikut 1). Suhu rektal dan kulit meningkat secara nyata. 2). Laju respirasi dan denyut jantung meningkat secara sangat nyata. 3). Nilai hematologi ternak tidak berbeda nyata dengan yang tidak dikerjakan.

I Introduction

Indonesia is an agriculture country where farmers still use their cows or buffalos as a source of labour to work in wet or dry soil. In general, Bali cattle is used to plow soil in order to produce foods (Masudana, 1990). Similar opinion was also reported by Ismed Pane (1990). Referring to Bali carttle as a draugh animal, it was chosen as a strategic animal to fulfil the requirement of labour in agriculture (Winogroho, 1990). Furthermore, he said that Bali cattle which work in one pair could pull a Java plow but not for a private modified plow. In some countries, diversification of the using of animal labour can be seen as a draught animal i.e. to carry some agriculture products. According to Santoso *et al.* (1990) the distribution of Bali cattle at some transmigration areas in Indonesia was expected to support agriculture develop-ment and income per capita of local farmers. Bali cattle has a very important function in agriculture soil preparation at that areas. Farmers who have no cows (limited capital) could work for a small area only (less than 1 Ha) while farmers who have cows they could work in area for more than 1 Ha. Apparently, the animals' labour is a limiting factor.

Bali cattle which was used to work resulted a higher physiological change i.e. heart beat, respiration rate and body temperature than that of the other cattle (Sukarji *et al.*, 1990). In this case the animal which was being worked would affect its physiological response. Djagra (1990) also reported that male buffalos which were being worked under hot sun shine resulted an increase of body temperature of 1.3°C (from 37.6°C to 38.9°C). Other workers, Mahardika *et al.* (1997) reported that some physiological responses on female buffalos which were being worked for 3 hours increased heart beat from 42 become 140 times/minute, respiration rate from 31 become 110 times/minute, skin and rectal

temperatures from 36.9 and 37.7°C become 40.2 and 40.8°C respectively.

Radiation of the sun shine affects the physiological of Bali cattle, Ongole and Madura very much (Komarudin and Teleni, 1991). The sun shine would increase heart beat, respiration rate and skin temperature but, none to rectal temperature.

Komarudin *et al.* (1991) stated that Bali cattle, Ongole and Madura which were loaded 11.8% of their body weight resulted heart beat for 60, 56 and 58 times/minute respectively but there is no difference on their skin and rectal temperatures.

Work causes oxigen needs of muscle and heart increases due to the increment of metabolism in the body (Parakkasi, 1986) as a consequency of the increment of physical activitiy during working. Thus, skin and rectal temperatures would increase up to 40.2 and 40.8°C respectively (Mahardika, 1996).

Effendi and Yazir (1982) found in human being that the heavier the load was given to him the higher the heart beat.

In general, the total blood volume of animal is about 7 - 8% of its live body weight. Wlile plasma is about 45 - 65% of the total blood volume, and the rest (35 - 55%) is red blood cells (RBC). Blood cells consists of erythrocytes, leucocytes/WBC (Coles, 1980).

Hemoglobine (Hb) is the pigment of erythrocytes, is a complex, iron - containing, conjugated protein composed of a pigment and a simple protein. The protein is globin, a histone. The red colour of Hb is due to heme (a metallic compound) with an iron atom in the centre of the porphyrin molecule. Porphyrin is made of four pyrole compounds (Swenson, 1970).

The primary function of Hb in the body depends on Hb which bounds with oxygen (O_2) at the lungs, then release it towards capilaries of tissues. The capacity of Hb for transfering O_2 depends on Fe atom in Hb. The concentration of Fe in Hb is 0.33 mg/gHb, so the capacity of Hb for transfering O_2 is about 1.36mg/gHb. The concentration of Hb in the blood varies, depending on age, sex and disease, species, O_2 pressures, season, altitude etc. (Swenson, 1970). According to Mitruka and Rawnsky (1977). the normal concentration of Hb on cattle is about 7.70 - 18.5 g/100ml.

Packed Cells Volume (PCV) is expressed as a percent volume of packed cells in whole blood after centrifugation. Most species of domestic animals have PCV values from 38 - 45% with a mean of 40 (Swenson, 1970). PCV values of cattle from 29 - 44% (Smith and Mangkoewidjojo, 1988). PCV values is affected by some factors such as breed, sex, age, environment and temperature (Swen-son *loc.cit*), total erytrocytes, size and volume of erythrocytes (Benjamin, 1978). Decreasing of PCV volume is due to disease, malnutrition, duration and rotation of centrifuge and diameter of tube centrifuge (Coles, 1980).

Effect of work on total erythrocytes, Hb and PCV of cattle was reported by George *et al.* (1972) that Brown Swiss and male Sahiwal (F_1) cross bred which was being worked for 2 hours resulted a decreasing of Hb. Other worker, Telani *et al.* (1991) also reported that animals were which being worked resulted an alteration of metabolotes (PCV) in their blood.

The alteration of hematology values as a result of work may affect physiological process in the body and this would diturbs the animal health. Anggorodi (1974) said that if the feed is insufficient, minerals requirement of the animal also could not be fulfiled. Hematology of an animal is affected by some factors such as environment, temperature, altitude, age, sex, breed, disease, parturation and physical activities (Jain, 1986).

II Materials and Methods

2.1 Animal

Three pairs (6) of female Bali cattle with body weight ranges from 255 - 268 kg per head were used in this experiment. The experiment was conducted at Negara, Bali for 2 months.

2.2 Shelter

Each pair of the cattle was kept in a shelter, completed with feed and water holders.

2.3 Plow

An ordinary or a traditional plow was pulled out by each pair of the cattle in rice field.

2.4 Stetoscope

A stetoscope was used to measure the heart beat of each cattle.

2.5 Stop Watch

A stop watch was used to count the respiration rate per minute of each animal.

2.6 Thermometer

A digital thermometer was used to measure the rectal and skin temperatures of each animal.

2.7 Scale

A scale of 1000kg capacity (5 kg sencitivity) was used to weigh body weight of each animal.

2.8 Other instruments

Syringes, venoject tubes, centrifuge, ice box, reaction tubes etc. were used in this experiment.

2.9 Chemicals

Some chemicals were used in this experiment i.e. heparin, alcohol, aquadest, Turk and Hayem solutions, Hcl 0.1N etc.

2.10 Weighing

The animals were weighed before and soon after working.

2.11 Feed and Water

Feed (local grass) and water were given *ad lib*.

2.12 Blood samples collection

Blood samples were collected through jugular vein (Smith and Mangkoewidjojo, 1988).

2.13 Measurement

Rectal and skin temperatures were measured with digital thermometers through the animals' anus and skin, respectively. Respiration rate was measured by counting inspiration and expiration per minute (with stop watch), while heart beat with stetoscope. All measurements were conducted before and soon after working.

2.14 Statistical Analysis

The data were analyzed with student test (Snedecor and Cochran, 1961).

III Results and Discussion

3.1 Rectal and Skin Temperatures

The average rectal and skin temperature of Bali cattle being worked were 5.94 and 9.17% higher respectively (Table) and significantly different ($P < 0.05$) than those of the animals with did not work. The increasing of these temperatures was due to the energy requirement of the working animal which was higher than that of non working animal; therefore their metabolism rate and heat production also increased. The increasing of the heat production causes heat absorption by the body, and it is also increasing thus rectal and skin temperatures increase automatically. Bali cattle is a homeotherm animal. The animal releases heat from its body through skin and consequently the skin temperature would increase (Barrett and Larkin, 1974). Similar opinion was also reported by Mahardika (1996) that rectal and skin temperatures of buffalos which were being worked increased up to 40.8 and 40.2 °C respectively.

Because of the limitation of references about physiological responses on working Bali cattle, some references on buffalos would be involved in further discussion as a comparison.

3.2 Respiration Rate

The average respiration rate of the cattle which were being worked was 119.35% higher (Table) and highly significantly different ($P < 0.01$) than that of the animals which did not work. This matter was due to more oxygen that was needed by the body where the emission of carbon dioxyde and heat were also high to counter high heat production. The results of this experiment was supported by the work of Mahardika (1996) that the increasing of respiration rate on working animal was due to more oxygen that was needed.

Table. Physiological responses of Bali cattle which were being worked

Variable	Before working	After working
1. Rectal temperature (°C)	36.7	38.9*
2. Skin temperature (°C)	34.9	38.1*
3. Respiration rate (times/minute)	31	68**
4. Heart beat (times/minute)	60	133**
5. Erythrocytes (10^6/mm^3)	4.1233	4.2666
6. Hemoglobine/Hb (g/100ml)	9.73	10.17
7. Leococytes (10^3/mm^3)	5.93	5.90
8. Packed Cells Volume/PCV (%)	26.00	27.00

*P < 0.05
**P < 0.01

While Wirahadikusuma (1980) said that this phenomena was presented by high glucose concentration of the animals' blood due to gluconeogenesis at work. This would stimulate glycolisis process. Consequently, respiration rate increased.

3.3 Heart Beat

The average heart beat of the cattle which were being worked was 105.00% higher (Table) and highly significantly different (P<0.01) than that of the animals which did not work. This was due to the requirement of energy of working animal that was greater than that of the animals which did not work. In this case, they need more nutrients and oxygen through blood circulation where the heart function as a pump and it must work harder (heart beat increases) to produce more energy. The results of this experiment was supported by Mahardika *et al.* (1994) that the increase of heart beat of animals (buffalos) being worked depends on the load (burden) given to the animals. The heavier the load, the higher the heart beat.

3.4 Erythrocytes

The average total erythrocytes of cattle being worked was 3.48% higher (P > 0.05) than that of the cattle the did not work (Table). In this case, the increasing of erythrocytes of the animals was not significant. This may due to the work that was not so hard. Therefore, the requirement of oxygen for working did not increase greatly in the blood (HbO_2) thus the total number of erythrocytes was not much affected.

In general, the total number of erythrocytes of cattle ranges between 6 - 8 millions/mm^3 (Swenson, 1970), 5.8 - 10.4 millions/mm^3 (Smith and Mangkoewidjojo, 1988), 5 - 8 millions/mm^3 (Coles, 1980), but in this experiment it was only 4.1233 millions/mm^3. This may due to the difference of breed, age, sex, altitude, pregnancy status, parturition, physical activities, disease etc. (Jain, 1986).

3.5 Hemoglobine (Hb)

Hb concentration of the cattle being worked was 4.52% higher (P > 0.05) than that of the cattle that did not work (Table). This matter has a connection to the concentration of the erythrocytes. The concentration of Hb is affected by total amount of erythrocytes (Coles, 1980 and Ganong, 1983). Because of the increase of the concentration of erythrocytes, the concentration of Hb also increased. Mitruka and Ranwsky (1977) reported that the concentration of Hb ranges between 7.70 - 18.5g/100ml. Results of the experiment showed that the concentration of Hb was 9.73g/100ml; this means that the concentration of Hb is still in normal range.

3.6 Leococytes

The total number of leococytes of the cattle that did not work and being worked 5.93

and 5.90 thousands/mm^3, respectively (Table). The difference was not significant (P > 0.05). Both figures mentioned above were lower than normal concentration of leucocytes (7.000 - 10.000/mm^3) (Swenson, 1970). This may due to the difference of breed, age, sex, season, altitude, parturation, physical activities, disease, pregnancy status etc. (Jain, 1986). Leucocytes especially neutrophils, may increase greatly in bacterial infections; while in viral disease they may decrease (Swenson, loc.cit.).

3.7 Packed Cells Volume (PCV)

The average values of PCV of the cattle being worked was 3.85% higher (P > 0.05) than that of the cattle that did not work (Table). PCV values was affected by the total number, size and volume of erythrocytes (Benjamin, 1978 and Ganong, 1983). The lower the total number of erythrocytes and Hb concentration, the lower the PCV values (Jain, 1986).

Conclusion

From the data mentioned above if could can be concluded that : 1). Rectal and skin temperatures increased significantly on female Bali cattle being worked (2 hr). 2). Respiration rate and heart beat increased highly significantly on the animal being worked (2 hr). 3). Hematology values of the animals were not significantly different between the animals being worked and the animals that did not work.

Suggestion

This experiment is necessary to be continued with more variations on different duration of works over Bali cattle which then can be related to tiredness of the animals.

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