EFFECTS OF WORK ON BLOOD GLUCOSE, TRIGLYCERIDES AND LACTIC ACID CONCENTRATIONS OF THE BALI CATTLE

W. Sayang Yupardhi[1]

ABSTRACT

Bali cattle had been spread out in some provinces or islands of Indonesia as well as over seas. However, the publication of the blood biochemistry data of Bali cattle as draught animal are still limited so far. The objective of this experiment was to study the blood biochemistry profile i.e. glucose, triglycerides and lactic acid concentrations of the cattle after doing work in rice field for a period of 2 hours. Three pairs of the mature female Bali cattle were used in this experiment. The experiment was conducted for 2 months at Negara, Bali. Measurements were conducted on the blood glucose, triglycerides and lactic acid concentrations with the methods of GOD - PAP by using a spectrophotometer (type 720) for glucose and lactic acid while Colorymeter Test was used for triglyceride analysus. Data were analyzed with student t test. Results of the experiment showed that work activity increased significantly blood glucose, triglyceride and lactic acid concentrations of the animals.

(Key Words : Bali Cattle, Glucose, Triglycerides, Lactic Acid).

PENGARUH KERJA TERHADAP KONSENTRASI GLUKOSA, TRIGLISERIDA DAN ASAM LAKTAT DARAH SAPI BALI

INTISARI

Saat ini sapi Bali dapat dijumpai di beberapa daerah atau pulau di Indonesia (Riau, Jambi, Sumatra, Kalimantan, Sulawesi, Maluku, Nusa Tenggara, Irian Jaya dan lain-lain) seperti halnya di beberapa negara di luar negeri (Australia Utara, Malaysia etc.). Namun data tentang biokimia darah ternak tersebut belum banyak terungkap (dipublikasikan). Tujuan penelitian ini adalah untuk mempelajari biokimia darah antara lain konsentrasi (kadar) glukosa, trigliserida dan asam laktat sapi Bali tersebut setelah dikerjakan di sawah selama 2 jam. Dalam penelitian ini telah digunakan 3 pasang (6 ekor) sapi Bali betina dewasa. Penelitian ini dilaksanakan selama 2 bulan di Negara, Bali. Pengukuran konsentrasi atau kadar glukosa dan asam laktat darah telah dilakukan masing-masing dengan metode GOD - PAP menggunakan spektrofotometer (jenis 720) sedangkan trigliserida menggunakan kalorimetri tes. Data yang diperoleh dianalisis dengan "t test". Hasil penelitian menunjukkan bahwa kerja yang dilakukan dapat meningkatkan secara nyata konsentrasi (kadar) glukosa, trigliserida dan asam laktat darah sapi Bali.

(Kata Kunci : Sapi Bali, Glukosa, Trigliserida, Asan Laktat).

Buletin Peternakan 24 (1) : 12 – 16, 2000

[1] Faculty of Animal Husbandry, Udayana University, Denpasar 80231 Bali.

Introduction

Up to now, Bali cattle can be found in some provinces or islands of Indonesia i.e. Riau, Jambi, South Sumatra, Lampung, West and South Kalimantan, North and South-East and South Sulawesi, Maluku, West and East Nusa Tenggara, Irian Jaya and Biak (Masudana, 1990). They could also found in Northern Territory of Australia and Malaysia, while the Bali island it self is the center of the Bali cattle development (Darmaja, 1980).

Bali cattle is known as an animal of multi purposes i.e. as draught animal, social economic aspect and religious need, tourist attractions (Gerumbungan at Buleleng, North Bali) etc. In Bali, most of farmers still keep their cattle as draught animal in wet or dry fields, particularly in undulate areas where the using of agriculture machineries is inefficient (Soeharto, 1981). Therefore, the Bali cattle is still be maintained as a draught animal (save energy). Unfornately, scientific data of the animal were not much being published yet particularly the blood chemistry profile of the Bali cattle as a draught animal. Referring to that case, this experiment was conducted to study the blood biochemistry profile of this animal i.e. glucose, triglyceride and lactic acid concentrations. These data are expected to be useful as an additional information in blood biochemistry profile of the Bali cattle.

Glucose is the last and the main product of carbohydrate metabolism (source of energy for human being) in blood (Ganong, 1992 and Poedjadi, 1994). This glucose was derived from foods' carbohydrate, various glucogenic compounds and liver glycogen. Glucose concentration in blood is a very important factor to controle the presence of the glucose in the liver (Martin *et al.*, 1992). The function of glycogen in the blood is as a reserve glycogen (Lehninger, 1991 and Poedjadi, 1994). This glycogenesis process occours in the liver and muscle, it is began with catabolism of glycogen to be glucose-1-phosphate through a process called phosphorolysis, a reaction with phosphate acid which involving phosphorylase enzyme. Futherrace, the glucose-1-phosphate in the liver is altered to be glucose-6-phosphate and then to be glucose and phosphate by phosphatase enzyme. The glucose flows into the blood towards whole body tissues (Lehninger, 1991).

Glucose synthesis from non carbohydrates such as lactic acid and some amino acids is called gluconeogenesis (Poedjadi, 1994). The liver and spleen (mammal) are the major organs which are responsible in the gluconeogenesis (Martin *et al.*, 1992).

Triglycerides are the most efficient fat as a source of calory for some processes which needs energy in the body (Linder, 1985). Its character is non hydrated and less oxidated substances. There are as much as 99% of triglycerides could found in fat cells and some in non adipose tissues i.e. liver and meat (as an energy recourses). Triglycerides can be converted into cholesterol, phospholipid and other fat. As an adipose, the triglyceride is also functions as a sleeper and protector of bounds and other vital organs.

In a condition of anaerobic glycolysis where oxidation process is not running well, lactic acid would be formed (Wirahadikusumah, 1985). This would affects the Krebs cycle (out of order) where pyruvate is reversed into lactic acid by dehydrogenized of lactic with NADH as its energy resources.

Materials and Methods

Animal

Three pairs (6) of mature female Bali cattle with live weight ranging between 255 - 268 kg were used in this experiment. The experiment was conducted at Negara, Bali.

Feed and drinking water

During the experiment, the cattle were fed (local grass) and watered *ad lib*.

Shelter

Each pair of the animals was kept in a shelter which is completed with feed and water places.

Chemicals

Some chemicals were used in this experiment i.e. heparin (anticoagulant), alcohol (70%), blanc solution, KIT reagent, strip reagent, aquadest and URAC solution, lactic reagent (LDH, NAD and GPT) etc.

Instruments

Spectrophotometer, syranges (10 ml), venoject tubes (10 ml) centrifuge, ice box, reaction tubes (5 ml), cuvet and plow were used in the experiment.

Measurements

Glucose, triglycerides and lactic acid blood concentrations were measured before and after the animals doing work activity in rice field. Glucose and lactic acid concentration were measured with the method of GOD - PAP, while triglycerides concentration with Colorymeter Test.

Blood samples collection

Before and after work , blood samples of the cattle were collected through jugular vein (Smith and Mangkoe widjojo, 1988) by venoject with heparin, then they were placed in ice box. Laboratory analysis of the bloods was conducted at Prodia Laboratory, Jl. Diponegoro, Denpasar.

Blood glucose concentration measurement

The concentration of blood glucose was measured with the method of GOD - PAP by using a spectrophotometer (type 720).

Triglycerides concentration measurement

The method of Colorymetry (wave length of 546 nm) test was used in this experiment. Principally, trigelyceride would be hydrolyzed by lypase enzyme to bo glycerol and free fatty acids. The glycerol would reacts with ATP to form glycerol - 3 - phosphate, then with NAD would becomes dihydroxiacetone-phosphate and $NADH_2$. The $NADH_2$ with INT would form formazene.

Lactic acid measurement

The concentration of lactic acid was measured with the method of LDH - GPT and NAD by using a spectrophotometer with wive length of 365 nm.

Statistical analysis

Data were analyzed with student t test (Snedecor and Cochran, 1961).

Results and Discussion

Glucose concentration

The average concentration of blood glucose in Bali cattle before doing work was 42.00 mg/dl, while after work (2 hr) it was 44.67 or 15.22% higher (Table) and significantly different ($P < 0.05$) than those of the animals before work. The increasing in glucose concentration on Bali cattle after work were due to : 1)the increasing of mobilization of glucose, 2) deposit of muscle glycogen, 3) glucose synthesis of amino acids and glycerol and 3)retardation of blood glucose flows into cells (Mahardika, 1997).

Table. The Average Concentration of Glucose, Triglyceride and Lactic acid on female Bali Cattle

Measurement	Before work	After work (2 hr)
Initial live weight (kg). ^{ns}	261.00	261.00
Glucose consentration (mg/dl) *	42.00	44.67
Triglycerides concentration (mg/dl) *	20.00	28.33
Lactic acid (nM) **	27.22	290.41

* = ($P < 0.05$); ** = ($P < 0.01$); ^{ns} = non significant

Triglycerides concentration

The average blood concentration of trigelycerides on Bali cattle before work was 20.00 mg/dl and but after work (2 hr) it was 28.33 or 40.17% higher (Table) and significantly different ($P < 0.05$) than those of the animals before work. This was due to the requirement of energy on working animals was higher than non working animals and this energy would be supplied by fat for more than 50% of their requirement (Komarudin and Teleni, 1991). On draught animals their energy resources initially were derived from carbohydrate then it is changed with an energy from fat. This results support the work of Mahardika (1997) who reported that the animals which were used for working would change their energy resources from carbohydrate to fat. In this case, hormones status are also change as indicated by epinephrine, thyroxine and glucagon increase, while insuline decrease and all of these resulted an increasing of lipase activity thus it increases lipolysis processes and finally blood triglycerides concentration is also increase (Power and Howly, 1991).

Lactic acid concentration

After doing work, the concentration of lactic acid in the blood of the animals increased highly significant ($P < 0.01$) than the animals before doing work (Table). This was due to the increment of metabolic rate in a condition of anaerobic. This results an accumulation of NADH and decreasing of NAD, thus citric acid cycles as a source of energy becomes less and less. In this case, glycolysis process was used as a source of energy. This process in anaerobic results lactic acid. The results of this work was supported by Guyton (1976) that in heavy exercise, during which large amounts of lactic acid are realized into the blood from the skeletal muscles. Furthermore he stated that in human being the great amount of lactic acid that forms during anaerobic glycolysis does not become lost from the body, for when oxygen is again available, the lactic acid either can be reconverted to glucose or can be used directly for energy. By far the greater proportion of this reconversion occurs in the liver, but a small amount can also occur in some other tissues. Heart muscle is especially capable of converting lactic acid to pyruvic acid and then utilizing this for energy. When a person begins to breath oxygen again after a period of anaerobic metabolism, the extra NADH and H^+ as well as the extra pyruvic acid that have built up in the body fluids are rapidly oxidized, thereby greatly reducing their concentrations. As a result, the chemical reaction for formation of lactic acid immediately reverse it self, the lactic acid once again becoming pyruvic acid. Large portions of this are immediately utilized by the citric acid cycle to provide additional oxidative energy, and large quantities of ATP are formed. This exceed ATP then causes as much as three-forths of the remaining excess pyruvic acid to be converted back into glucose.

Conclusion

Work activity increased significantly blood Glucose, triglycerides and lactic acid concen-trations of Bali cattle

References

Darmadja, D. 1980. Setengah Abad Peternakan Sapi Tradisional dalam Ekosistem Pertanian di Bali. Disertasi Universitas Padjadjaran.

Ganong, W. F. 1992. Review of Medical Physiology. ed. 14 th. Alih Bahasa oleh Petrus Adrianto. EGC. Penerbit Buku Kedokteran.

Guyton, A. C. 1976. Textbook of Medical Physiology. 5th ed. W.B. Saunders Co. Phyladelphia, London, Toronto.

Komarudin, M. and E. Teleni. 1991. The Effect of Solar Radiation on The Physiology of Ongolo (Bos indicus), Bali (Bos sondaicus) and Madura Cows. DAP. Bull.2.

Lehninger. 1991. Dasar-dasar Biokimia. Ed. 2. Alih Bahasa oleh Thanawijaya. Penerbit Airlangga.

Linder, C. M. 1985. Nutritional Biochemistry and Matabolism. Department of Chemistry. California State University Fullerton.

Mahardika, I. G. 1997. Kebutuhan Energi Untuk Kerja pada Kerbau di Daerah Tropik Lembab. Fakultas Peternakan Universitas Udayana, Denpasar.

Martin, J. R., P. A. Mayes, D. K. Granner, V. W. Rodwell. 1992. Harper's Review of Biochemistry. 20th ed. Alih Bahasa oleh Iyan Darmawan. ECG. Penerbit Buku Kedokteran.

Masudan, W. 1990. Perkembangan Sapi Bali di Bali Dalam Sepuluh Tahun Terakhir (1980-1990). Buku Panduan, Kumpulan Makalah Utama dan Abstrak. Seminar Nasional Sapi Bali. Fapet UNUD Denpasar, Bali.

Poedjadi, A. 1994. Dasar-dasar Biokimia. Penerbit Universitas Indonesia.

Power, S. K. and E. T. Howley. 1991. Exercise Physiology. Theory and Application to Fitness and Performance. WM.C. Brown Publisher.

Snedecor, G. W. and W. G. Cochran. 1961. Statistical methods. 5th ed. The Iowa State Univ. Press. Ames. Iowa. USA.

Soeharto, P. R., Sudi Murtini dan Taryadi. 1981. Masalah Ternak Kerbau dan Mekanisasi Pertanian. Proceding Seminar Penelitian Peternakan. Departeman Pertanian. Bogor.

Wirahadikusumah, M. 1985. Biokimia: Metabolisme, Energi, Karbohidrat dan Lipid. Terbitan I. Penerbit ITB Bandung.