THE IMPACT OF SWEET ORANGE WASTE IN RATIONS ON BLOOD PROFILE AND WEIGHT GAIN OF PADJADJARAN RAMS

Elvia Hernawan[1*], Lovita Adriani[1]

[1]University Padjadjaran, Bandung, Indonesia

Abstract

The research was conducted to evaluate the blood profile and body weight gain as a result of the provision of sweet orange waste (SOW) on 20 Padjadjaran rams with the average body weight around 29.5 ± 3.08 kg. The research used completely randomized design (CRD). Four treatments of SOW (0, 4, 6 and 8 %) were used in the ration and each treatment was repeated 5 times. The measured variables were erythrocytes, hemoglobin, hematocrit, leukocyte, and body weight gain. Result of the observation for each treatment (R1, R2, R3 and R4) were 7.96 – 8.68 x10^6/μL for erythrocytes, 10.78 – 11.66 g/dL for hemoglobin, 26.34 – 29, 44% for hematocrit and leukocyte from 6.19 – 8.3 x10^6/μL. Analysis of variance showed that blood profile and body weight gain were not significantly different. In conclusion, the provision of sweet orange waste (SOW) up until 8% in the ration, physiologically have no negative impact on blood profile and body weight gain.

Key words: sweet orange waste (SOW), blood profile, Padjadjaran rams

INTRODUCTION

Animal husbandry product usually contains high cholesterol and fat; therefore nowadays people are more selective to choose their diet. This condition surely affects people preference on animal husbandry product, therefore now is the right time for an innovation to produce high quality products that have content low cholesterol and fat.

The using of herbal materials for decreasing cholesterol and fat on blood have published so many times, one of the herbal material is sweet orange (*Citrus sinensis*) waste. It has so much potential to decrease cholesterol and fat level on animal or human. Sweet orange waste contains some active components such as tannins, saponins, flavonoids, pectin and essential oil. These compounds have a certain benefit for body for example; saponins are natural detergent that cleans intestinal wall [7] as well as antimicrobial. Flavonoids are anti-oxidant polyphenols compounds that protect cell membrane structure from oxidative stress [11]. Meanwhile tannins and pectin have a specific role in order to retain cholesterol and fat absorption on digestive tract [20]. Pectin are D-galacturonat acid polymer with D-1,4 linkages. It located in the centre of lamella on the cell wall and functioned as glue between cells or tissue stabilizer [9]. Pectin does not have a fixed structure; pectin's characteristics are can form jelly, soluble on water but also can be deposited or dried. Sweet orange waste (SOW) has 15-25% pectin content of the orange weight [12].

Indonesia is in 14th rank in the orange production in the world. Orange fruits production in Indonesia is up to 1,611,784 ton [2], meanwhile the waste are around 60% of the fruit itself. The waste consists of 60-65% orange skins, 30-35% skin's membranes and 0-10% seeds [15].Unfortunately, the waste is not used to its potential. Many industries just discard it; one of them is orange beverage industry.

Attempt to decrease cholesterol and fat levels on Padjadjaran ram's blood by using SOW was feared to harm the ram's biological function especially rumen's ecology and its hematology that also can affect on animal's productivity. Blood profile is a key indicator to determine the animal

*Corresponding author: hernawan.elvia@yahoo.com
The manuscript was received: 01.06.2014
Accepted for publication: 05.09.2014

physiological condition. It becomes important to evaluate hematological profile and body weight gain as a manifestation of livestock productivity under sweet orange waste provision to ration of Padjadjaran ram.

MATERIAL AND METHOD

This research used 20 male Padjadjaran rams with weight average of 29.91 ± 3.08 kg. Ingredients and nutrient contents of the ration in this research can be seen in Table 1. Some of the active components that can be analyzed from SOW are pectin (14.6%), tannins (0.95%), saponin (0.84%), flavonoids (0.46) and Essesial oil (0.95%) [13] The ration was given in 300 grams of concentrate and 2.825 grams of forage. It was determined according to maintenance, activities and 150 g/head/day average daily gain. The forage was a mixture of *Brachiaria brizantha* grass and *Pennisetum purpureu*. These grasses were acquired from the breeding station at Faculty of Animal Husbandry of Padjadjaran University.

Blood samples were taken from the jugular vein on the last day of this experiment. Then the erythrocytes, hemoglobin, MCH, MCHC, MCV, hematocrit and leukocytes were counted and analyzed by Hematological Analyzer device at Pramitha Laboratory in Bandung.

The average daily gain was calculated by subtracting weight at the end of observation with the beginning then divided by observation time. Meanwhile daily consumption was calculated by subtracting the accumulation of ration given daily with the accumulation of its residue then divided by observation time. Feed conversion ratio (FCR) was calculated by dividing ration consumption and body weight gain multiplied by 100%.

Table 1 Ration's Ingridients and Nutrient Contents

Ingredients	Nutrient Content (100% BK)						
	BK	ASH	CP	CF	CF	BETN	TDN
	---------- % ----------						
Rice Brand	87.70	13.60	11.00	14.00	8.60	50.90	67.90
Palm Oil Cake	86.00	4.10	15.00	22.00	11.90	44.60	79.00
Tofu Waste	14.60	5.10	30.30	22.20	9.90	32.50	77.90
Coconut Cake	86.00	8.20	19.00	14.00	10.90	45.40	78.00
Citrus sinensis	90.01	7.70	6.50	12.76	3.40	0	79.00
CGF	90.40	4.33	17.71	20.11	5.40	0	73.68
Bean peel	90.75	24.30	9.18	25.80	4.49	0	50.70
Molases	82.40	11.00	3.90	0.40	0.30	84.40	70.70
Pollard	88.50	5.90	18.50	9.80	3.90	61.90	69.20
Cassava Cake	79.80	2.40	1.80	8.90	0.30	86.50	78.30
Source : Proximate Analysis by Laboratorium Ternak Ruminansia dan Kimia Makanan Ternak, Fakultas Peternakan University Padjadjaran (2010)							

Hematological Profile

The average hematological values of Padjadjaran rams that were given SOW in the ration were seen in Table 2. The lowest average value of erythrocytes (7.96 x 10^6 /dL) was obtained from the ration with 8% SOW level, meanwhile the highest value was obtained from the 0% SOW level. Figure 1 showed that the more SOW used in rations the more erythrocytes tend to decrease. Statistical analysis showed that it is not significantly different, so that the used of SOW until 8% was showed the same values of erythrocytes.

The average of erythrocytes on the rams is stated in Table 2. It can be seen that the values were below the standard of healthy ram which is 10-13 x 10^6/mm^3 [19] or 9-15 x 10^6/dL [18]. There are many factors that affect erythrocytes values such as age, sex,

animal condition, nutritional status, exercise and environment [19]. In this research, it was possibly happen because of the age factor. The rams were not mature yet so that the erythrocytes values were below the standard [19]. Another reason was because of the active components especially saponins. Saponins have biological activity that can affect the permeability of erythrocyte cells membrane by making pores that will cause it to break [7]. Saponins also act as surfactant that decreases the surface tension so that the cell will break [8]. On the other hand flavonoids in the SOW were known to act as antioxidant and anti-inflammatory that protect the cell membrane from oxidative stress that usually attack the membrane of bilayer lipid [11]. All of the active compounds found in SOW seemed to be in a contradictive interaction that cause the erythrocytes values in rams remain the same with the one that were not fed with SOW.

SOW provision also did not affect hemoglobin levels ($p>0.5$). Hemoglobin levels on the rams fed by SOW were not significantly different with the one that were not fed by SOW according to statistical analysis. Averages of hemoglobin level on the rams were not different with the healthy rams that is 11 g /100mL [6]. This condition suggests that even though the erythrocytes values were below the healthy standard, the hemoglobin levels were still in normal range. Hemoglobin is an erythrocyte pigment consists of conjugated complex protein that contains zinc. It has a key role to respiration system especially in the exchange of O_2 and CO_2. If the value decreases, it will effect on rate of metabolism. There was a possibility that the normal values of hemoglobin was caused by physiological demand to maintain hemoglobin level by homeostasis process and protein reform. Saponins will likely to reduce the hemoglobin level because it is able to form a bond with a Fe ion with two valences [3]. This condition will interfere the Fe absorption and synthesis process of hemoglobin. In this research, this condition did not happen because the saponins content on SOW were still under minimum standar (0.2%) so that it did not affect the hemoglobin values.

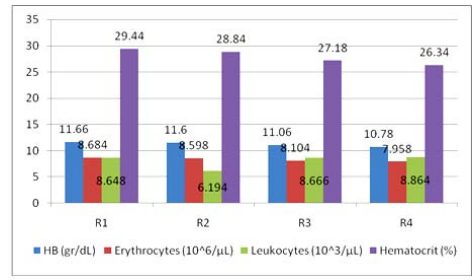

Figure 1 Average Hematological Values of LJM Provision on Padjadjaran 1 Rams

Furthermore, hemoglobin level can be use as indicator to determine health status of the animal. The indicators are the average of erythrocyte volume (MCV), the amount of hemoglobin weight on every cell of erythrocyte (MHC) and the average of hemoglobin concentration on every cell of erythrocyte (MCHC). In this research, those indicators showed a similar result from the provision of SOW (0, 4, 6 and 9%) to the normal values in rams. The values of those indicators can be seen at Table 2. Those values are similar to the standard value of MCV (30-44 fL), MCH (10-14 pg) and MCHC (27-36 g/dL). The rams with SOW provision will functionally have normal hemoglobin values, despite of the low erythrocyte level. This means there is enough hemoglobin to sustain metabolism process especially hemoglobin function to form bond with oxygen in order to sustain cellular respiratory. It will help to form energy to maintain activity of cells, tissues, organs and other functions.

Hematocrit level were not significantly different ($p>0.05$). The rams that were not fed by SOW provision ration have lower values compared to the healthy rams which the value were 32 – 45% [18]. This condition happened because of the erythrocytes values were also low. The value of erythrocyte, hemoglobin and hematocrit were directly proportional [19].

Leukocytes are body protection unit that act non-functional. They are synthesized in a different place and will be transported to the inflammatory area or a mobile leukocyte unit was transported to work when needed. In this research, the leukocytes values of the rams

were not statistically significant (p>0.05). It means the SOW provision did not cause any non specific harm. The lowest leukocytes value was R2 treatment (4% SOW) with 6.19 x 10^3 µL, meanwhile the others (R1, R3 and R4) were in the normal range which was between 8.65 – 8.83 x 10^3 µL. In comparison, the healthy ram has leukocytes value between 7–10 x 10^3/cu.mm [18]. Thus, the rams in this research were not suffered any infection or inflammation. Meanwhile in R2 treatment, there is a possibility that the neutrophills decreased because of viral infection [19].

Table 2 The Average of Hematological Profile on Padjadjaran 1 Rams with SOW Provision on Ration

Variables	R1	R2	R3	R4
Erythrocytes (10^6/µL)	8.68	8.60	8.10	7.96
Hemoglobin (gr/dL)	11.66	11.60	11.06	10.78
Hematocrit (%)	29.44	28.84	27.18	26.34
MCV (fL)	33.90	33.52	33.40	33.08
MCH (pg)	13.46	13.52	13.78	13.60
MCHC (g/dL)	39.70	40.38	41.34	41.08
Leukocytes (10^3/µL)	8.65	6.19	8.67	8.83

Body Weight Gain

The averages of rams body weight gain were shown in Table 3. The highest value was R3 treatment (84.16 head/day), the second highest was R4 (76.16 g/ head/day), then R2 (60.11 g/head/day) and R1 (57.89 g/head/day). It showed that SOW provision can increase daily body weight gain, especially with 6% provision. Meanwhile 8% provision showed a tendency of decreasing as showed in Figure 2.

Statistical analysis showed that body weight gain for every treatment were not significantly different (P>0.05). That means that SOW provision on ration until 8% gave a relatively same in body weight gain. The ration used in this research was design to gain 150 g/head/day. It consists of 2.825 grams of forage and 300 grams of concentrate. The whole portion of the ration was usually consumed by the rams but the highest average daily gain happened only to R3 treatment (6% SOW) with 84.16 g/head/day. One of the possibilities for this condition was because the rams were passed the accelerating growth phase, so the growth rate became slower. Other possibility was the rams cannot optimize the nutrient content in the ration perfectly.

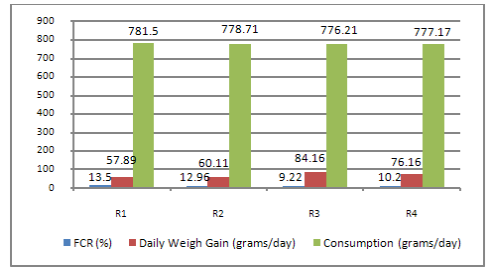

Figure 2 The Average of Feed Conversion Ratio (FCR), Daily Weight Gain and Ration Consumption on The SOW Provisioned Padjadjaran Rams

Table 3 The Average of Daily Body Weight Gain, Consumption and Feed Conversion Ratio on The SOW Provisioned Padjadjaran Rams

Variables	R1	R2	R3	R4
Average Daily Gain (g/head/day)	57.89	60.11	84.16	76.16
Consumption (g/head/day)	781.50	778.71	776.21	777.17
FCR (%)	13.50	12.96	9.22	10.20

The average of ration consumption on every treatment resulted in a close range between 776.21-781.50 g/head/day as shown in Table 3. The results were also not significantly different (P>0.05). The amount of ration consumption fit the statement that

dry matters consumption of rams is will likely to be 2-3% of its weight [1]. Body weight gain is a criterion that can be used to evaluate quality of the ration or feed because it is a result of utilization of the feed and nutrient in it. The overall average daily gains in this research were between 57.64 – 84.16 g/head/day. The highest body weight gains were R3 and R4 with 84.16 and 76.16 g/head/day. Those treatments showed to be able to convert feed to 9.29% (R3) and 10.20% (R4). Consumption level to 9.22% showed the same level of consumption suggested [16], but it was lower than the one that suggested [10]. But the highest values of feed conversion was resulted by treatment R1 (0% LJM) with 13.50% then followed with R2 (4% LJM) with 12.96%. This condition indicated that the rams not efficiently optimizing the dry matter on ration. Thus, there is also possibility that provision 6% of SOW on ration can efficiently optimizing ration, meanwhile the provision of 8% of SOW will decrease the ability to convert or optimize ration.

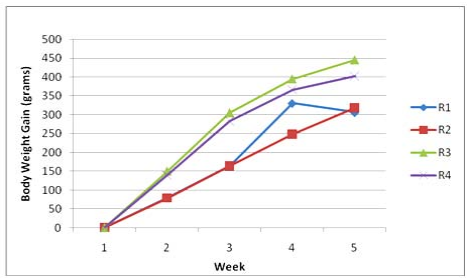

Figure 3 The Average of Body Weight Gain Per Treatment Per Week

All of the condition regarding ration consumption was suspected to happen because of active components such as tannins, saponins, flavonoids, essential oil and pectin in SOW. Tannins is able to precipitate protein on saliva. The feeling of dry in mouth will affect ration consumption even the animal can refuse to eat the ration consist of tannins above 20 mg/g of the dry matter. Besides that, tannins can reduce permeability of intestine wall by reacting to cellular wall outside the intestine wall which will block the nutrient absorption process [5]. The tannins content in ration in this research were calculated to be 0.76% or 5.9 mg/g of its dry matter. It means that it still fall under safe category and will not have a negative effect. According to [17] the use of tannins on small amount (< 2-3%) on ruminantia's ration will become benefit as it can protect protein from excessive degradation by microbial.

Saponins content from the SOW on the ration were less that 0.67%, meanwhile flavonoids content were less than 0.36%. Saponins act as natural detergent meanwhile flavonoid act as anti-oxidant [20]. Those two components were likely to interact on the body, even though metabolism process of flavonoids are hard to understand, especially in process of decreasing the status of oxidant plasma [11]. On the other hand, essential oil does not affect process of fiber absorption because its content is still under the minimal limit of 0.2% [4].

CONCLUSIONS

In conclusion, provision of sweet orange (*Citrus Sinensis*) waste on ration up to 8% on Padjadjaran 1 rams does not give a negative effect to hematological profile and body weight gain as seen from physiological point of view.

ACKNOWLEDGEMENTS

Acknowledgements and gratefulness should be given to Padjadjaran University's rector that had sponsored this research by BOPTN 2013, and Prof Dr. Ir. Sri Bandiati Komar Prayoga that had facilitated the Padjadjaran rams for this research. Also thank you to all of students (Lalan Jaelani, Michelle Roselyn, Satrio Budi Nugroho, Galih Ahmad Abdullah) who helped in this experiment.

REFERENCES

[1] Bamualim A., Peran Peternakan dalam usaha tani di daerah Nusa Tenggara. Jurnal Penelitian dan Pengembangan Pertanian.VII(3), 1988,p 69-74

[2] BPS. 2012. Produksi Buah-buahan dan Sayuran Tahunan di Indonesia, 1995-2012. diunduh dari http://bps.go.id/tab_sub/view.php?kat=3&tabel=1&daftar=1&id_subyek=55&notab=5 pada tanggal 20 desember 2013 pukul 20.00 WIB.

[3] Cheeke. Saponin : Suprising benefits of desert plants, http:www.lpi.oregonstate.edu/sp-spdp/saponin.htm. 2000,(6 Mei 2009)
[4] Ella, Maria Ulfa., Ketut Sumiartha., Ni Wayan Suniti., I Putu Sudiarta dan Nyoman Semadi Antara, Uji Efektivitas Konsentrasi Minyak Atsiri Sereh Dapur (*Cymbopogon Citratus (DC.) Stapf*) terhadap Pertumbuhan Jamur Aspergillus Sp. secara In Vitro. E-Jurnal Agroekoteknologi Tropika : Vol. 2(1), 2013
[5] Fahey, G.C. and L.L. Berger.Carbohydrate Nutrition Of Ruminants.in The Ruminant Animal Digestive Physiology And Nutrition Ed. D..C.Church, A.Reston Book. Prentice Hall, Engewood Cliffs, New Jersey, 2002, p 283 -285.
[6] Francis G., Zohar K, Harinder P.S. Makkar HP, and Becker K, The biological action of saponin in animal systems : A review, J. Nutr. British 88, 2002, p 587-605.
[7] Frandson, Anatomi dan Fisiologi Ternak Ed ke 4, Penerjemah Ir. B. Srigandono, MSc dan Drs. Koen Praseno, SU. Gajah Mada University Press. 1996.
[8] Gunawan D., dan S. Mulyani, Ilmu Obat Alam (Farmakognosi), Jilid I, Penerbit Penebar Swadaya, Yoyakarta, 2004
[9] Hariyati M.N., Ekstraksi Dan Karakterisasi Pektin Dari Limbah Prosespengolahan Jeruk Pontianak (*Citrus nobilis* var microcarpa), Skripsi, Fakultas Teknologi Pertanian, Institut Pertanian Bogor, 2006
[10] Haryanto, B. Dan S.N. Jarmani. Performans Domba sebagai Respons terhadap Pemberian Pakan Mengandung Bungkil Inti Sawit Terproteksi Molases Peternakan. Seminar Nasional halTeknologi dan Veteriner, 2010, p 554 -549
[11] Heim. K.E. A.R. Taqliaferro. D.J. Bobilya. Flavonoid antioxidant: Chemistry, metabolism and structure activity relationships. Jour. of Nutritional Biochemistry. Vol 13(10), 2002, p 571
[12] Ikrawan, Y., Dede, Z. Rahmawati, Rika dan Arief, Pengaruh konsentrasi pektin dan suhu pengeringan terhadap karakteristik fruit leather stroberi *(Fragaria chiloensis L).* Artikel ilmiah(7), 2005, p55-68.
[13] Laboratorium Kimia Organik, Analisis Kimia Tepung Limbah Jeruk manis (*Citrus sinensis*). Fakultas MIPA, Universitas Padjadjaran, Bandung, 2013
[14] Laboratorium Nutrisi Ternak Ruminansia dan Kimia Makanan Ternak. Analisis Proksiamat Tepung Limbah Jeruk manis (*Citrus sinensis*). Sumedang: Fakultas Peternakan, Universitas Padjadjaran, 2010
[15] Mirzaei-Aghsaghali, A., and Naser Maheri-Sis, Nutritive Value of Some Agro-Industrial By-products for Ruminants – A Review, World Journal of Zoology 3 (2), 2008, p 40-46
[16] NRC, Nutrient Requirement of Sheep, Academic Press, Washington DC, USA, 1985
[17] Olerumi, O.I.A., Ngi J., dan I.A. Andrew. Phytonutrients in citrus fruit peel meal and Nutritional Implication for Livestock Production. Livestock Research For Rural Development. University of Agriculture, Makurdi Benue State. Nigeria, 2007
[18] Smith dan Mangkoewidjojo, Pemeliharaan, Pembiakan dan Penggunaan Hewan Percobaan di Daerah Tropis.Cetakan pertama. UI Press. Jakarta, 1998
[19] Swenson, M.J., Physiological Properties and Cellular and Chemical Constituents of Blood In Swenson, M.J. (Edition), Duke's Physiology of Domestic Animals 10th Edition Cornell University Press, Ithaca and London, 1984
[20] Widodo, Wahyu. *Tanaman Beracun Dalam Kehidupan Ternak*. UMM press, 2005.