Giving of Formulated Pellet on Javan Porcupine (*Hystrix javanica* F. Cuvier, 1823): Effects on Feed Intake, Feed Conversion, and Digestibility in Pre-Domestication Condition

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ABSTRAK

Pemberian pelet formula pada landak Jawa (*Hystrix javanica* F. Cuvier, 1823) : pengaruhnya terhadap konsumsi, konversi pakan, dan kecernaan pada kondisi pra budidaya. Penelitian telah dilakukan untuk mengetahui pengaruh pemberian pelet formula pada landak Jawa terhadap konsumsi, konversi pakan, dan kemampuan cerna. Penelitian berlangsung selama 40 hari (12 hari *preliminary* dan 28 hari masa pengumpulan data) di Penangkaran Mamalia Kecil, Bidang Zoologi, Pusat Penelitian Biologi – LIPI, Cibinong. Selama penelitian, delapan ekor landak masing-masing ditempatkan di dalam kandang metabolik berukuran 1,4 m x 1,2 m x 1,0 m (panjang x lebar x tinggi). Rancangan penelitian adalah rancangan acak lengkap terdiri dari 4 perlakuan ransum dan dua ulangan yaitu ransum kontrol (T0), ransum diberi pelet formula 50 g/ekor/hari (T1), ransum diberi pelet formula 100 g/ekor/hari (T2), dan ransum diberi pelet formula 150 g/ekor/hari (T3). Hasil penelitian menunjukkan tingkat kesukaan landak Jawa terhadap jenis pakan penelitian berturut-turut adalah bengkuang, ketimun, talas belitung, pelet formula, kangkung, jagung manis, daun kitengis, kelapa, ubi jalar, dan kunyit. Konsumsi nutrien, kecuali lemak pada perlakuan pemberian pelet formula (T1, T2, T3), lebih tinggi dibanding perlakuan kontrol (T0). Konversi pakan pada landak T0 lebih tinggi dibandingkan pada landak T1, T2, dan T3, masing-masing 12,45%; 8,15%; 6,98%;, dan 5,58%. Kecernaan bahan kering adalah 94,44% (T0); 95,79% (T1), 95,08% (T2); dan 97,16% (T3), sedangkan kecernaan bahan organik adalah 94,55% (T0), 96,16% (T1); 95,64% (T2); dan 97,45% (T3). *Total digestible nutrien* (TDN) tinggi pada semua perlakuan, yaitu 90,40% (T0); 92,69 % (T1); 92,03% (T2); dan 94,25% (T3) yang menggambarkan landak mampu mencerna semua nutrien pakan dengan baik.

Kata kunci: pelet formula, konsumsi, konversi pakan, kecernaan, *Hystrix javanica*

INTRODUCTION

Porcupine (Hytricidae: Rodentia) which means “pork with spines” is a unique mammal. Its upper body covered with hard feathers resembling cylindrical sharp spines, ringed black or dark brown and white, while the lower part of its body covered with short black hairs a bit rough. Spines in the porcupine’s body are modifications of its hair body.

In Indonesia, the spread of this species includes Sumatera, Kalimantan, Java, and Bali. Common porcupine (*Hystrix brachyura*) scatters in Sumatera and Kalimantan, while javan

porcupine (*H. javanica*) is spread only on the island of Java. Borneo porcupine (*Thercurus crassispinis*) is endemic to Kalimantan. Javan porcupine or also called sunda porcupinne is endemic to Indonesia with the characteristic of large body size. In captivity, porcupines give birth 1 to 2 times a year with litter size at birth varied from 1 to 3 with most litters (58.8%) being of singletons, 32.1% were of twins, and 9.1% of triplets (van Aarde 1985).

The porcupine is a monogastric herbivore. They eat a wide variety of vegetation, including grasses, sedges, flowers, leaves, twigs, roots, buds, catkins, and seeds of many other plants. Also, in the wild areas, porcupines gnaw on shed deer antlers to get mineral content (Banfield 1974).

Although the status of porcupine is protected, illegal hunting toward this animal is considered on the increase. People in the some regions of Indonesia believes that porcupine's meat and other parts of its body containing drug efficacy. The spines of the porcupine are used for ornamental purposes.

In Banting, Selangor, Malaysia, in 2005 a farm of common porcupine has established, which is the pioneer of commercial farm of porcupines. It indicates that porcupine has a good prospect in the future, because its meat can be consumed to meet the needs of animal protein and can be used as drug material, while its spines can be used for the making of souvenirs. The efforts of breeding of this animal are needed to anticipate the extinction of porcupines in Indonesia.

The breeding of porcupine in the captivity must be able to create a condusive environment for the life of porcupine. To create a captive resembling original habitat of porcupine it is needed to measure its feed peference, feed consumption, feed conversion, and digestibilty ability. Also, it is urgent to estimate the feed or diet consumed by porcupine in the captivity. Feed given in the captivity should be able to meet the nutritional needs for basic necessities of life, growth, reproduction, and other daily activities of porcupine. Proper feeding management of the porcupines in captivity is the key of successful breeding colony development.

This study aims to determine food preferences, consumption, feed conversion, digestibility ability, and nutrient needs for maintenance and production of javan porcupine, so this animal can be preserved.

MATERIALS AND METHODS

This research has been conducted in the Small Mammals Captivity, Zoology Division, Research Center for Biology - LIPI, Cibinong. The study lasted for 40 days, consisted of two periods of 12 days of preliminary study and 28 days (4 weeks) of data collection. Materials of research using 8 javan porcupines, aged between 3 and 6 months. During the study, each porcupine is placed in metabolic cage with the size of (1.4 m x 1.2 m) x 1.0 m in height.

The experiment was designed in a completely randomized design with 4 ration treatments and 2 replications. The

rations were given as follows: control ration (T0), and 3 treatments with the addition of formulated pellets into the rations of each 50 g (T1), 100 g (T2), and 150 g (T3) per head per day (Table 1). Types of feed given during the study were sweet corn (*Zea mays*), sweet potato (*Ipomoea batatas*), coconut (*Cocos nucifera*), cucumber (*Cucumis sativus*), yam bean (*Pachyrhizus erosus*), turmeric (*Curcuma longa*), swamp cabbage/water spinach (*Ipomoea aquatica*), kitengis leaf (*Asystasia* sp.), cocoyam (*Xanthosoma sagittifolium*), and the formulated pellet (Table 1). Drinking water available is *ad libitum*. Feed was delivered twice a day, at 08.00 a.m. and 04.30 p.m. Variables observed include feed intake, weight gain, feed conversion, and digestibility. Porcupine is weighed at the beginning and at the end of the study to determine its growth. The weighing was carried out before the feed is delivered. The amount of feed consumed and the remain are weighed and recorded every day, as well as the amount of feces excreted each day by using total collection method (Tillman *et. al*. 1991). Analysis of dry matter (DM), ash, crude lipid (CL), crude protein (CP), energy, nitrogen-free extractives (NFE), calcium, and phosphorus were carried out according to standard procedure of AOAC (1995). Nutrient content of feed and feces is necessary to calculate digestibility nutrients (Naumann & Bassler 1997). Consumption of dry matter and nutrients is determined by measuring the ration of dry matter and nutrients given minus dry matter and nutrients in the feces. Digestibility of dry matter and nutrients is calculated by subtracting the dry matter and nutrients consumed with dry matter and nutrients present in feces. Data were statistically analyzed by analysis of variance using model of SAS (2000) and differences between treatment tested by Duncan's multiple range test (Snedecor & Cochran 1980).

Table 1. Composition of ration experiment.

Food item	Treatment (g/head/day)			
	T0	T1	T2	T3
Sweet corn	200	0	0	0
Sweet potatoes	200	0	0	0
Coconut	75	0	0	0
Cucumber	100	200	200	200
Yam bean	190	340	340	290
Turmeric	10	10	10	10
Swamp cabbage	50	100	100	100
Kitengis leaf	25	50	50	50
Cocoyam	150	250	200	200
Formulated pellet	0	50	100	150
Totals	1,000	1,000	1,000	1,000

Notes: T0 = Control; T1 = Treatment 1; T2 = Treatment 2; T3 = Treatment 3

RESULTS

Analysis result of nutrient content of feed materials given to porcupine during the study are listed in Table 2.

Environmental conditions of the captivity such as temperature and humidity will greatly affect the feed intake and the condition of porcupine. As reported by Church & Pond (1988), feed consumption can be influenced by several factors, namely (1) internal factors (physiological status of animals), (2) external factors (feed and temperature), and (3) the environment. The result of average temperature and humidity measurements during the study at 00.00 a.m., 07.00 a.m., and 05.00 p.m. are 23.27 °C and 93.64%, 29.25 °C and 72.16%, and 25.33 °C and 89.02% respectively

Consumption of feed material used in this study listed in Table 3. The consumption on the feed material by porcupine as protected wildlife should be determined in order to know the types of feed materials preferred. Porcupine selects the types of feed to meet its need of energy and nutrients.

Porcupine of T1, T2, T3 (Table 4) consumes more OM, ash, CP, NFE, GE, and mineral Ca and P compared to porcupine of T0. This can be explained by the fact that porcupine of T1, T2, and T3 gets extra feed, namely formulated pellet, so that the pellet has been supplying nutrients in the rations. Tillman *et. al.* (1991) stated that feed intake is influenced by the shape and physical characteristics of feed, and also by chemical composition, frequency of feeding, and anti-nutrients in the ration.

Figure 2 shows the live-weight gain of porcupine occurred in all treatments of ration. Live-weight gain is a mirror of the feed quality given and relates well with the amount of feed given. The high consumption on protein and energy by porcupine of T1 (Table 4) have shown the high live-weight gain compared with

Table 2. Composition of nutrients base on dry matter (100%)*.

Food item	DM	Ash	CP	CL	CF	NFE	GE	Ca	P
	……..……(%) ……						cal/g	…... (%) .	
Sweet corn	20.67	3.03	14.16	7.16	1.62	74.03	4,411	0.08	0.50
Sweet potatoes	23.36	2.94	3.20	0.90	8.40	84.56	3,661	0.32	0.17
Coconut	55.40	1.82	7.67	8.91	13.50	68.10	6,161	0.06	0.17
Cucumber	18.72	6.37	20.84	0.94	0.30	71.55	3,682	0.66	0.48
Yam bean	33.07	3.24	5.25	0.96	5.66	84.89	3,739	0.65	0.29
Turmeric	27.60	12.98	6.01	1.34	7.86	71.81	4,127	0.38	0.35
Swamp cabbage	21.68	9.62	24.63	2.91	12.59	50.25	4,072	0.63	0.37
Kitengis leaf	29.48	17.99	17.26	0.91	37.42	26.42	3,641	0.53	0.29
Cocoyam	70.92	8.23	13.60	2.43	13.11	62.63	3,990	1.14	0.32
Formulated pellet	98.39	4.86	25.84	4.67	3.86	60.77	4,900	0.51	0.51

Notes: DM = dry matter; CL = crude lipid; NFE = nitrogen free extrative; Ca =calsium, CP= crude protein; CF = crude fiber; GE = gross energy, P = Phosporus, * Laboratory of Nutrition Testing, RC for Biology – LIPI (2010).

Table 3. Fresh matter intake (FMI), dry matter intake (DMI), and proportion of DMI.

Food item	FMI (g/head/day)				DMI (g/head/day)				Proportion of DMI (%)			
	T 0	T1	T2	T3	T 0	T1	T2	T3	T 0	T1	T2	T3
Sweet corn	151,88	0,00	0,00	0,00	31,39	0,00	0,00	0,00	12,87	0,00	0,00	0,00
Sweet potatoes	44,07	0,00	0,00	0,00	10,30	0,00	0,00	0,00	4,22	0,00	0,00	0,00
Coconut	64,47	0,00	0,00	0,00	35,71	0,00	0,00	0,00	14,64	0,00	0,00	0,00
Cucumber	99,47	199,43	111,97	194,25	18,62	37,33	20,96	36,36	7,63	9,47	6,78	9,47
Yam bean	159,63	335,74	324,58	281,97	52,79	111,03	108,65	93,25	21,64	28,16	35,16	24,27
Turmeric	2,61	4,29	2,25	1,91	0,72	1,18	0,62	0,53	0,30	0,30	0,20	0,14
Swamp cabbage	42,07	90,00	42,41	61,36	9,12	19,51	9,19	13,30	3,74	4,95	2,98	3,46
Kitengis leaf	15,43	34,23	15,57	22,68	4,55	10,09	4,59	6,69	1,86	2,56	1,49	1,74
Cocoyam	113,79	234,06	112,05	142,77	80,70	165,99	79,47	101,25	33,09	42,11	25,72	26,36
Formulated pellet	0,00	49,90	86,93	134,93	0,00	49,09	85,53	132,76	0,00	12,45	27,68	34,56

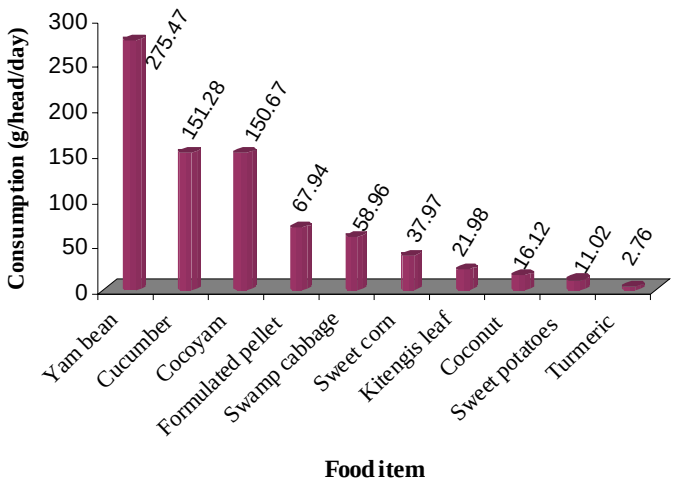

Figure 1. The palatability level of feed fresh by javan porcupine.

Table 4. Consumption of ration and nutrients.

Nutrients	T0	T1	T2	T3
Consumption (g/head/day)				
DM	243.89^{a}	394.23^{c}	309.01^{b}	384.13^{c}
OM	230.66^{a}	368.36^{c}	291.67^{b}	361.46^{c}
Ash	13.23^{a}	25.87^{c}	17.34^{ab}	22.67^{c}
CP	28.22^{a}	55.49^{bc}	46.07^{b}	65.01^{c}
CL	8.48^{a}	8.42^{a}	7.48^{a}	10.35^{b}
CF	22.72^{a}	36.38^{c}	22.86^{a}	28.00^{b}
NFE	171.24^{a}	268.07^{c}	215.25^{b}	258.09^{c}
GE (cal/head/day)	10407.76^{a}	15765.09^{b}	12762.92^{ab}	16177.18^{b}
Ca	1.55^{a}	3.29^{c}	2.27^{b}	2.80^{bc}
P	0.79^{a}	1.39^{b}	1.16ab	1.52^{c}
Consumption (% DM)				
OM	94.58	93.44	94.39	94.10
Ash	5.42	6.56	5.61	5.90
CP	11.57^{a}	14.08^{ab}	14.91^{ab}	16.92^{b}
CL	3.48	2.14	2.42	2.69
CF	9.32^{b}	9.23^{b}	7.40^{a}	7.29^{a}
NFE	70.21^{b}	68.00^{ab}	69.66^{ab}	67.19^{a}
GE (cal/100 g DM)	4267.40^{b}	3998.96^{a}	4130.26^{ab}	4211.38^{b}
Ca	0.64^{a}	0.83^{b}	0.73^{ab}	0.73^{ab}
P	0.32	0.35	0.38	0.40

Notes:DM= oragnic matter

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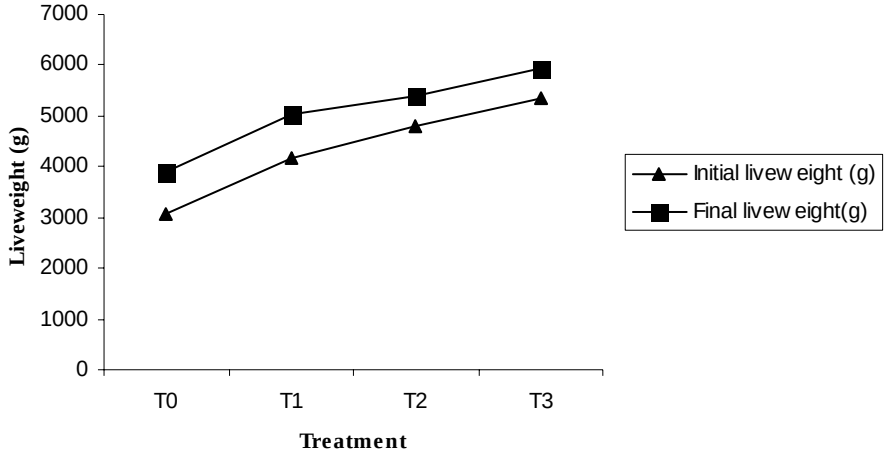

Figure 2. Changes in liveweight of javan porcupine during the experiment.

porcupine of T2 and T3. This is due to the fact that porcupines of T0 and T1 were younger than those of T2 and T3, so that the body growth is still high. In line with the results of this study, Dahlan *et. al*. (1995) reported that young porcupine consume more food than adult porcupine, so that live-weight was also higher. According to Linder (1992), the most rapid growth phase occurs in early development.

DISCUSSION

Feed palatability factors are important in measuring feed intake in animals (Tomaszewska *et. al*., 1991). Figure 1 shows the average level of palatability on the types of fresh feed most preferred by porcupine, from the most consumed, yam bean (275.47 g/ head/day), to the least consumed, turmeric (2.78 g/head/day) . Formulated pellet ranked fourth level of palatability: porcupine consumes pellets up to 98.18% (T1), 86.93% (T2), and 89.95% (T3) from each of 50 g (TI), 100 g (T II), and 150 g (T III) formulated pellet given (Table 3). This fact indicates the porcupine like pellets, and as reported by Dahlan *et. al.*(1995), Norsuhana *et. al.* (2007), and Farida (2007), that pellet can be used as an alternative food in management of common porcupine (*H. brachyura*) in captivity.

Based on the field observation and information from the public, porcupines in their natural habitat like roots, but in this experiment turmeric is the type of feed or roots which is consumed least. This was allegedly because the porcupine still has the choice of other, more palatable feed given in this study. From the tuber, yam bean was preferred over sweet potato and cocoyam, this is because the yam is sweet and contains crude fiber were lower than the sweet potato and cocoyam (Table 2). Reported by Tafaj *et. al*. (2005), feed intake is closely related to digestibility and rate of flow of

feed material in the digestive tract that are largely determined by content of crude fiber. Feed that has high content of crude fiber in the rumen retention takes longer than feed that has lower crude fiber content. Consumption of high crude fiber resulted in decreased number of consumption.

According to Church (1988), the high fiber content of feed ingredients consumed causing increased pressure on the rumen wall, so that bring in physiological effect on the decreased in appetite. However, the fiber in the diet is necessary to ensure the natural digestibility (Schroeder 2004). The next sequence of the feed type preferred by porcupine is cucumber. This is due to the low crude fiber content and high content of water in the cucumber so that the cucumbers were soft when consumed and can meet the needs of porcupine for water. During the observation, it is almost invisible porcupine drinking from the drinking water provided.

Based on the calculation of dry matter consumed by porcupine, it is known that the dry matter intake of the porcupines in T0, T1, T2, and T3 are 6.25%, 7.81%, 5.72%, and 6.46% of live-weight, respectively. According to Parakkasi (1999), animals consume feed primarily to meet energy needs, and the higher the need for energy, the higher the consumption of dry matter.

More protein is consumed by porcupine in T1, T2, and T3, because protein content in the formulated pellet given in those treatments is quite high among other food item (Table 2). According to Men *et. al*. (2001), the presence of feed ingredients with high protein content can increase the palatability, thus causing the high consumption of feed. The high consumption of protein (T1, T2 and T3) is followed by the high consumption of GE. According to Hocquette *et. al.* (1998), the process of protein synthesis and degradation in the body requires more energy. Trevino *et. al.* (2000) reported that nitrogen retention is one method for assessing protein quality of feed.

Ash consumption is also higher on porcupine in T1, T2, and T3 than that on porcupine in T0. The high ash content allegedly came from minerals namely calcium, sodium, potassium, and phosphorus (Made & Kasih 2008). In addition, CaCO3 were given in the making of formulated pellets. Measurement of Ca and P consumption is to know the ability of porcupine in the absorption of Ca required for the growth of its spines. As reported by Banfield (1974), porcupines like salt and for the fulfillment of these in their natural habitat they will gnaw the bones or antlers found on the forest floor to obtain the mineral content. Also according to Nowak (1991) and Roze (1989), porcupine often gnaw bones to get calcium. The giving of formulated pellets in porcupine's ration have increased consumption of calcium and phosphorus.

NFE is one of the most nutrient consumed by porcupine either in the treatment of T0 or in the treatment with formulated pellet (T1, T2, and T3). This is due to the feed nutrient given, except cocoyam (Table 2), containing high NFE

compared with other nutrients. Feed with high NFE means that the feed is easily digested and contain high energy. NFE is an easily digestible carbohydrates that do not contain crude fiber which consists of several components such as starch, fructose, resins, and organic acids used as energy sources (Tillman *et. al*. 1991).

CF consumption by porcupine of T1 is higher than that of T0, T2, and T3. This is due to the fact that the increase of formulated pellets given has decreased the consumption of CF. According to Schroeder (2004), fiber in the ration is necessary to ensure the natural digestibility. Energy consumption is higher on porcupine who gets formulated pellet than that of T0, but there are also differences in the amount of energy consumption among porcupines of T1, T2, and T3. The differences are probably related to body composition. According to Parakkasi (1999), the energy requirement of animals is influenced by factors of age, sex, body composition, and level of feeding.

Feed conversion or feed efficiency plays an important role in a livestock business because the cost of feed ranged between 60 - 70% of the production cost. The more efficient the use of feed, the lower the production cost. Feed efficiency can be seen from the feed conversion ratio which is the amount of feed required to produce one kilogram of body weight gain. In general, the lower feed conversion ratio, the better feed efficiency due to the amount of feed required to produce one kilogram of body weight become less. The amount of feed intake and body weight gain determine the amount of feed conversion. According to Leeson & Summers (2001), the number of rations consumed determines the size of body weight gain produced.

Feed conversion of porcupine of T0 is higher ($P < 0.05$) than that of T1, T2 and T3. While feed conversion of T1 is higher ($P < 0.05$) than that of T2 and T3. This is certainly related to lower live-weight gain obtained by porcupines of T2 and T3. Formulated pellets given up to 50 g per head per day in the treatment of T1 indicates that the amount is sufficient for the needs of porcupine. Feed consumed contain substances that will be absorbed in the digestive tract. The nutrients that remain in the body will be used to meet the needs of the body and to produce live-weight gain. As stated by Scott *et. al.* (1982), the amount of feed conversion is determined by the amount of feed intake and live-weight gain obtained. According to Tillman *et. al.*

Table 5. Feed conversion of javan porcupine

Variables	Treatment			
	T0	**T1**	**T2**	**T3**
Liveweight gain (g/head/day)	30.36^{ab}	32.14^{b}	21.58^{a}	21.43^{a}
DMI (g/head/day)	243.89^{a}	394.23^{c}	309.01^{b}	384.13^{c}
Feed conversion (%)	12.45^{c}	8.15^{b}	$6,98^{a}$	5.58^{a}

Notes: Different letter in the same row was significantly different ($P<0.05$)

(1991), the amount of feed efficiency depends on the amount of dry matter intake, which could give live-weight gain. A ration would be more efficiently used if it is consumed in small amount but able to provide the large live-weight gain. In addition, feed conversion ratio is affected by disease, quality of rations, and breeding management (North & Bell 1990).

Nutrients which is digested is defined as the proportion not excreted in feces and assumed to be absorbed by porcupine, while digestibility is the proportion of digested nutrients to nutrient consumption. Digestibility is more often expressed with dry matter as a coefficient of digestibility or percentage (Parakkasi 1999).

The highest digestibility value of dry matter occurred in ration given in T3, namely 97.16% (Table 7). This could have been caused by the fact that the consumption of crude fiber in T3 is lower ($P < 0.05$) than that in T0 and T1 (Table 4). According to Tillman *et. al.* (1991), CF from a feed is a component giving great effect on digestion, because high CF content in the ration can decrease the digestibility coefficients of feed.

Digestibility values of OM, CP, and CL on porcupine of T1, T2 and T3 are higher ($P < 0.05$) than that of T0. The low digestibility of CL on porcupine of T0 is due to the high CL excreted in its feces (Table 6). Digestibility of calcium of porcupine of T0 is higher ($P < 0.05$) than that of T1, T2, and T3. This is because of the low calcium excreted by the porcupine of T0. In general, it can be seen in Table 7, that porcupines in all treatments are able to digest nutrients properly, namely more than 90%. This indicates that most nutrients can be absorbed and then utilized by porcupine to meet its live need.

Food substances used in the calculation of TDN are all organic material that is energy source of food substances. TDN is one way to find the

Table 6. Dry matter and nutrient content of porcupine's feces.

Nutrients	Treatment			
	T0	T1	T2	T3
	(g/head/day)			
DM	13.56	16.59	15.19	10.91
OM	12.56	14.14	12.73	9.21
Ash	1.00	2.45	2.46	1.70
CP	2.51	3.66	3.77	2.16
CL	2.61	0.80	0.67	0.47
CF	1.95	3.63	3.07	2.17
NFE	5.48	6.03	5.23	3.73
GE (cal/head/day)	684.50	627.05	610.65	388.70
Ca	0.09	0.29	0.32	0.21
P	0.12	0.26	0.39	0.26

energy feed: the higher the TDN value of a feed, the better the feed for animals, which means more nutrients can be digested by animals. Table 8 shows that calculation result of TDN on T0 is lower ($P < 0.05$) than that on T1, T2, and T3 which are given formulated pellets. This is due to the fact that the high GE in the treatment of T0 which is excreted in the feces caused low GE digested and be followed by TDN value.

Basically the TDN is a measurement of energy content in digested feed. As reported by Parakkasi (1986), in general the TDN value of a feed material is proportional to the energy that can be digested, but varies according to the type of animal and the type of feed or ration. From Table 8 it can be seen that the TDN content of the feed given is quite high, namely above 90%, portraying that porcupine can digest all the nutrients feed properly.

Digestible energy (DE) is the percentage of food energy intake minus fecal energy divided by energy consumption of feed (Sutardi 1981). According to Cullison *et. al*. (2003), DE value represents how much energy is not excreted in the feces and then used as a

Table 7. Digestibility of nutrient of javan porcupine

Nutrients	Treatment			
	T0	T1	T2	T3
	---------- (%) ----------			
DM	94.44[a]	95.79[a]	95.08[a]	97.16[b]
OM	94.55[a]	96.16[ab]	95.64[a]	97.45[b]
Ash	92.44b	90.53[ab]	85.81[a]	92.50[b]
CP	91.11[a]	93.40[ab]	91.82[a]	96.68[b]
CL	69.22[a]	90.50[ab]	91.04[ab]	95.46[b]
CF	91.42[b]	90.02[ab]	86.57[a]	92.25[b]
NFE	96.80	97.75	97.57	98.55
Ca	94.19[b]	91.19[ab]	85.90[a]	92.50[ab]
P	84.81[b]	81.29[ab]	66.38[a]	82.89[b]

Notes: Different letter in the same row was significantly different ($P < 0.05$).

Table 8. Gross energy, total digestible nutrient (TDN), dan digestible energy (DE)

Variables	Treatment			
	T0	T1	T2	T3
GE intake (cal/head/day)	10407.76	15765.09	12762.92	16177.18
GE feces (cal/head/day)	684.50	627.05	610.65	388.70
GE digestibility (cal/head/day)	9723.26[a]	15138.04[b]	12152.27[ab]	15788.48[b]
TDN (%)	90.40[a]	92.69[ab]	92.03[ab]	94.25[b]
(% DE)	93.42[a]	96.02[ab]	95.22[ab]	97.60[b]
(Mkal/kg DM)	3.99	4.09	4.06	4.16

Notes: Different letter in the same row was significantly different ($P < 0.05$).

metabolic energy if it is reduced by energy excreted in the urine. DE calculation results showed that porcupines need energy intake amounted to 93.42% or 3.99 Mcal / kg DM (T0), 96.02% or 4:09 Mcal / kg DM (T1), 95.22% or 4:06 Mcal / kg DM (T2), and 97.60%, or 4:16 Mcal / kg DM (T3). The DE on the porcupine in all treatments showed higher values above 90%, and this means that the energy used by porcupine to make ends meet while in captivity is quite high.

CONCLUSION

Based on the level of palatability, porcupines like formulated pellets after yam bean, cucumber, and cocoyam provided in the ration. Formulated pellets given has increased the consumption of dry matter and nutrients, except for crude fat. It also has increased consumption of calcium and phosphorus. The highest feed conversion occurred in control treatment (T0), namely 12.45%, while among the three treatments of T1, T2, and T3, formulated pellets given up to 50 g / head / day (in T1) showed higher feed conversion ratios, namely 8.15%. Formulated pellets given in the ration has increased dry matter digestibility, nutrients, and calcium, followed by the high value of total digestible nutrients (TDN) and digestible energy (DE) above 90%, as an illustration that porcupines can optimize the utilization of feed energy for their daily needs.

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