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Research Article

Feeding selection by Timor deer (*Cervus timorensis* Blainville) in relation to chemical and physical properties of the forage plants at Bali Barat National Park

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Abstract

This study was conducted to determine the relationship feeding selection of timor deer (*Cervus timorensis*) by a factor of the chemical and physical properties of forage available in the habitat. Composition of plants in habitat analyzed with quadrat method and composition of the plant in the deer diet using microhistological analysis of feacal sample. Forage species selection were assessed using a ivlev's index of electivity. Chemical properties analyzed were crude protein with Semi-micro Kjeldahl technique; gross energy content (GE) with a bomb calorimeter technique; ADF fibers with Goering and Van Soest method; mineral content of calcium (Ca) and phosphorus (P) by using the technique of Atomic Absobs Spectrophotometer; and tannin content was analyzed by *folin denish* reaction. The physical properties of food plants tested were water regain capacity and water solubility. Relationship between selection with chemical and physical properties of forage were determined by multiple regression statistical test. The results showed that feeding selection of timor deer are influenced by the chemical (content of CP, GE, ADF) and physical properties (water regain capacity and water solubility) of forage plants species. Feeding selection index increases with an increase in protein content, calcium content, the value of water regain capacity and water solubility of forage species. The content of CP and tannins, water regain capacity and water solubility of forage species can be a predictor variables to predict the feeding selection of forage species by timor deer in the habitat, with the regression model are as follows: $Y = -2.31 + 0.14X_1 + 0.04X_2 + 1.99X_3 - 0.12X_4$ (Y= selection index; X_1 = content of CP; X_2 = water regain capacity; X_3 = water solubility; and X_4 = content of tannin; $R^2 = 0.706$; $P < 0.05$).

Keywords: Timor deer, feeding selection, chemical properties, physical properties.

Introduction

Feeding selection on wildlife in nature is a complex problem, because it involves a variety of factors, both factors related to the nature of each type of plant feed (*physical, chemical and biological*), the availability of forage, disturbance factors or predators presence, social behavior, learning behavior and also a result of the evolutionary process (Hanley,1997; Moser *et al*., 2006). Some research regarding the selection of plant species on timor deer (*Cervus timorensis*) in the wild indicate that deer are generalists or plants diversity of feed high category that takes a lot of plants species, both grasses, forbs, as well as woody plants (Ginantra *et al*., 2014; Allison, 2011; DeGarine-Wichatitsky *et al*., 2005; Pattiselanno and Arobaya, 2009). Even the deer are also said to be opportunistic herbivores, because in scarce forage situations can also eat leftovers in the trash.

Research results about feeding selection of the timor deer (*C. timorensis*) in nature is more focused on the availability of forage species in the habitat (DeGarine-Wichatitsky *et al*. (2005), Pattiselanno and Arobaya, 2009). Studies towards factors associated with physical properties (water regain capacity, water solubility), chemical properties (protein, energy, minerals, the content of the cell wall, and allelochemical) and biological properties (digestibility) of each species of forage plants have not been many do.

This study focuses on the relationship feeding selection on timor deer (*C. timorensis*) with factor of physical and chemical properties of each species of forage plants available in the habitat. Two of these properties are important to understand the role of nutritional factors in the feeding selection of animals in natural habitat. An understanding of the selection of food plants and nutritional factors can be a reference in the management of the habitat to support the conservation of timor deer in Bali Barat National Park (BBNP).

Materials and Methods

Study Area

Field research was conducted in four habitat units on BBNP, namely; Cekik unit, Prapat Agung, Segara Rupek, and Brumbun (Figure 1), from January to March 2013 (rainy season) and July to September 2013 (dry season). Located at coordinates $8^0 11'15.14"$ - $8^0 06'21.13"$ S and $114^0\ 26'25.45"$- $114^0\ 29'58.09"$ E, altitude between 4.90 to 90.84 m above sea level.

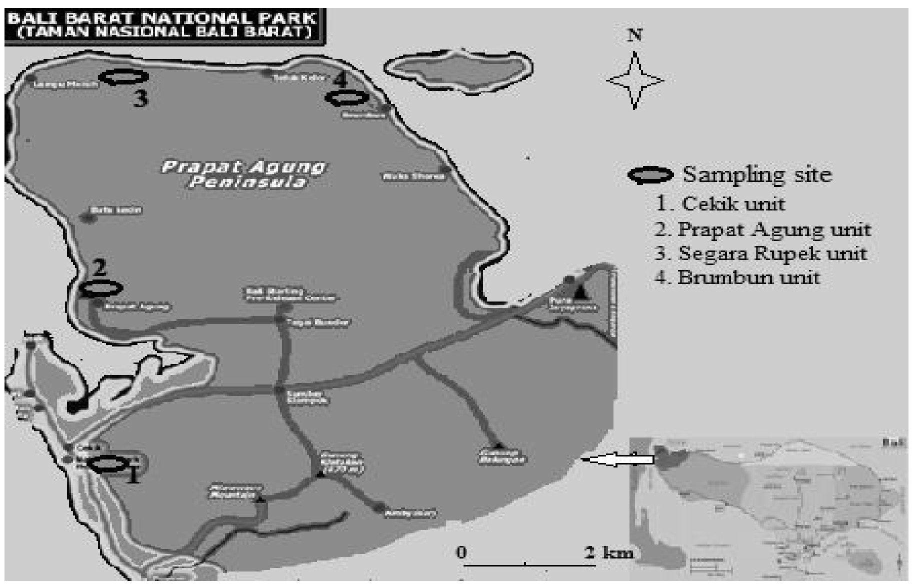

Figure 1. Location of study area at Bali Barat National Park

The type of vegetation in the habitat unit is savanna (Cekik, Segara Rupek and Brumbun) and Prapat Agung unit is a monsoon forest. Rainfall during the rainy season average of 220.17 mm/month and in the dry season average of 28.33 mm/month (data from BMKG region III Bali, 2013). Temperatures ranging from 24 ^{0}C to 37 ^{0}C and humidity ranging from 30 to 80%.

Analysis of Forage Species Composition in Habitat and in Deer Diet

Composition of plants species available in the habitat is determined by the quadrat method. Each quadrat 0.5 m x 0.5 m for grass/forbs vegetation, 1 m x 1 m for shrubs, and 5 m x 5 m for tree. Ten quadrats in each habitat unit applicated per month, up to in each habitat unit used thirty quadrats per season. Percent ground cover each plant species measured in the quadrat. For shrubs and tree vegetation, percent cover of shoot that's count up to 1.2 m height (height level can be access by timor deer). The composition of each plant in the habitat (*ai*) is determined by the equation:

$$\frac{\text{average cover species}-}{\text{total cover all sp}} \times 100\%$$

(average cover of species-i is the number of species-i cover divided by plot sampling) (Morrison, 2008).

Composition of plants species in the timor deer diet determined by techniques microhistological faecal sample (Holechek *et al.*, 1990). Fecal samples collected from five groups pellets at each habitat unit at 2-week intervals every month. Immediately collected fecal sample was dried (oven 70 0C) to avoid further decomposition. Samples on each habitat unit then compositing based on season to mikrohistology analysis. Identification of plant species in deer diets based on recognition of plant epidermic microscopic fragments preserved in the feces. Microscopic observations performed in the laboratory of plant taxonomy Udayana University of Bali. The composition of each plant in deer diets (*ri*) calculate by the formula:

$$\text{Composition of species-i} = \frac{\text{density species}-\text{i}}{\text{Total density all species}} \times 100\%$$

(density species-i is calculated based on the number of fragments of the epidermis of each species divided by the number slide total).

Forage selection were assessed using a ivlev's index of electivity (SI) (Krebs, 1989): SI= $(ri\text{-}ai)/(ri+ai)$, which is ai = composition (%) plant species-i in habitat, ri = composition (%) plant species-i in deer diet. SI values ranging from -1 to +1, where SI values 0.1 to 1 are indicate preference, 0.09 to -0.09 are proporsional, and -0.1 to -1 are avoidance.

Analysis of the Chemical and Physical Properties of Forage Plants

Samples of each species feed taken 250 grams of fresh ingredients in a period three times on each unit habitat. Each sample oven at 70 ^{0}C to obtain dry weight (DW). DW sample finely ground for analysis of chemical and physical properties. Crude protein (CP) analyzed by Semi-micro Kjeldahl technique, gross energy content (GE) by bomb calorimeter apparatus, fiber ADF (acid detergent fiber) analyzed by Goering and Van Soest method (Ranjhan and Krishna, 1980). Minerals (Ca and P) content were analyzed by atomic absorption spectrophotometer (Sinaga, 1997). Tannin content was analyzed by *folin denish* reaction (Suhardi, 1997).

The physical properties of each species of forage plants observed were water absorption (water regain capacity) and water solubility. Analysis procedure refers to Suhartati *et al*. (2004).

Statistical analysis

The relationship between the selection index with chemical properties (CP, Ca and P minerals, fiber ADF, tannins) and physical properties (water regain capacity and water solubility) of forage species used multiple regression statistical test. Test using the software "IBM SPSS 20".

Results and Discussion

Forage Selection by Timor Deer

There are 36 species were selected by the timor deer during the rainy season, which consists of 10 species of forbs, 18 species of graminoids, 8 species of woody plant. Thirty-eight species were selected in the dry season, which consists of 6 species of forbs, 17 species of graminoids, 15 species of woody plant. The same plant species were selected in the two seasons was found 26 species, which consists of 4 species of forbs, 16 species of graminoids, 6 species of woody plants. Nine species are selected only during the rainy season and 11 species were selected only in the dry season (Table 1).

Forage plant species on forbs category shows a high selection index in the two season. Based on selection index, nine of the ten species of this plant are selected in the rainy season preferred category (SI values 0.1 to 1). In the dry season, five of the six species of this plant are selected in preferred category. These species include *Commelina benghalensis*, *Boerhavia diffusa*, *Desmodium triflorum*, *Synedrella nodiflora*, and *Tribulus terrestris*. There are two species of plants are selected only in the dry season, namely *Vernonia patula* and *Justicia* sp.

In the category of graminoids, of eighteen species were selected in two seasons, 8 species is an important species for timor deer fodder in BBNP, because these species are preferred category (SI values 0.1 to 1). These species are; *Eriochloa ramosa*, *Axonopus compressus*, *Eriochloa subglabra*, *Dactyloctenium aegyptium*, *Panicum tryperon*, *Oplismenus Burmani*, *Digitaria adscendens, Eleusine indica*.

Some woody plant species the selection index is the fairly consistent in both seasons, including preference category as *Leucaena leucocephala*, *Grewia* *koordersiana* and *Hibiscus tiliaceus*. In general, the selection of category woody plant selection index showed improvement in the dry season. There are five species of plants that are not selected in the rainy season,only are selected at the dry season with preferred categories, namely *Bridelia monoica*, *Gliricedia sepium*), *Zizyphus mauritiana*, *Pluchea indica* and *Sida acuta*. The species of forage on woody plant have become important as timor deer fodder when forbs and graminoids limited availability in the habitat.

These results indicate that the timor deer was able to accommodate the availability of the plants in quantity and quality. Certain plant species could become not preferred because of the presence of other species of preferred or a species to be favored than before because there are limited species in habitat. Selection behavior can change depending on the availability of habitat unit and season. Ginantra *et al*. (2014) and DeGarine-Wichatitsky *et al*. (2005) found that variations in the availability of plants from category forbs, graminoids and woody at the different types of habitat and season determine the feding selection of timor deer. Hanley (1996) and Allison (2011), also stated that the availability of food plants in the habitat and season plays an important role in feeding selection behavior on deer.

Chemical Properties of Forage Species

Test of chemical properties (content of CP, GE, Ca, P, ADF and Total tannin), showing that the quality of the forage plants are available in BBNP is variaty. CP, mineral Ca and P content of forbs plants group is higher, but availability is high only during the rainy season. CP content of graminoids was lower, but GE content of its higher than forbs plants. CP content of woody plants and GE is high and availability is likely to be relatively longer than the forbs (Table 1). The same was reported by Amiri and Shariff (2012), Holechek (1984), that the content of the CP, GE and minerals vary based group of plants (forbs. Grasses, and woody plants).

Forage quality (in terms of the content of CP and GE) associated with the growth phase of a plant and environmental factors such as precipitation or soil moisture. The role of water is important for the metabolic process for the formation of organic compounds, so the content of CP and GE forage plants in the rainy season becomes higher than the dry season. This statement is supported by some researchers that there is a seasonal dynamics of the nutrient content of forage in their natural habitat (rangelands) associated with the availability of water for plant growth (Rollins, 2011; Memmott *et al*., 2011; Holechek, 1984). Further stated that the grasses and herbaceous dicots containing high nutrient levels when growth phase.

In general the tannin content of forage plants is still at a moderate level, which is less than 4% (Cannas, 2008). Tannin content of woody plants is relatively higher than forbs and graminoids. Holechek (1984), also reported that woody plants tend to contain a secondary metabolits including tannins higher than dicotyledonous herbaceous plants (forbs) and grasses category.

ADF content of forage species in forbs category is relatively lower than graminoids and woody plant category (Table 1). Results of this research is the logical consequence of lower ADF on forbs plants compared to others as a result of low fiber and high rough materials without nitrogen extract. Other researchers have also found that almost the same thing, namely grass (graminoids) is a group of plants that contain cell wall (ADF and NDF) tends to be higher than the herbaceous dicots (Amiri and Shariff, 2012; Holechek, 1984).

Physical Properties of Forage Species

Forbs and graminoids tend to decrease water absorption (water regain capacity) and water solubility in the dry season (Table 1). A decrease in physical properties is closely related to the aging phase of vegetative plant parts are accompanied by increased cell wall components (ADF and NDF). Water absorption and water solubility is influenced by the content of plant cell walls (fibers ADF), this statement can be proved by reference to the existence of a negative correlation between the content of ADF forage with water regain capacity and water solubility ($r = -0.450$ and $r = -0.632$) (Appendix 1 a). That is, the higher the content of the cell wall (ADF) plant, the water regain capacity and the solubility lower.

Unlike the case in woody plants, water absorption and water solubility (physical properties) relative almost the same in both seasons. Physiological conditions is due to the woody plants (shrubs and trees) plant parts

Table 1. Forage selection, chemical composition and physical properties of forage plants species in two season on BBNP (SI = selection index, CP= crude protein, GE= gross energy, Ca= Calcium, P= Phosphorus, ADF= acid detergent fiber, WRC= water regain capacity, and WS= water solubility)

		Rainy Season									**Dry season**						
No	***Forage species***	**SI**	CP %	GE MJ/kg	Ca %	P %	Tanin %	ADF %	WRC	WS	SI	CP %	GE MJ/kg	Ca %	P %	WRC	WS
	Forbs																
1	*Commelina benghalensis*	0.63	22.44	14.74	2.29	0.46	0.33	28.25	7.89	0.41	0.58	13.54	13.53	2.01	0.40	4.71	0.42
2	*Boerhavia diffusa*	0.58	24.99	14.25	2.01	0.33	0.34	37.02	3.00	0.45	0.46	21.69	15.50	3.62	0.40	3.90	0.45
3	*Tribulus terrestris*	0.54	16.10	15.76	3.30	0.40	0.30	37.14	6.18	0.38							
4	*Desmodium triflorum*	0.51	21.92	16.48	1.48	0.45	0.52	35.17	6.29	0.47	0.24	17.23	17.66	1.52	0.16	3.84	0.42
5	*Fleura interupta*	0.50	16.36	17.52	1.50	0.38	0.61	42.77	5.63	0.43							
6	*Tephrosia pumila*	0.47	21.77	18.87	1.53	0.30	0.73	38.51	3.32	0.33	-	-	-	-	-	-	-
7	*Borreria laevis*	0.29	22.07	15.00	1.93	0.52	0.31	37.43	2.82	0.47	-	-	-	-	-	-	-
8	*Synedrella nodiflora*	0.28	21.25	14.68	1.95	0.71	0.39	46.34	2.38	0.48	0.56	20.13	14.89	2.56	0.51	3.41	0.38
9	*Acalypha indica*	0.28	19.81	14.80	3.87	0.59	0.47	34.05	3.75	0.47							
10	*Vernonia cinerea*	-0.24	16.13	13.97	2.09	0.14	0.43	44.71	3.22	0.51							
11	*Vernonia patula*										-0.06	14.24	18.67	1.58	0.35	3.19	0.26
12	*Justicia* sp.										0.50	17.05	13.65	4.75	0.25	4.10	0.33
	Graminoids/grasses																
1	*Eriochloa ramosa*	0.66	11.24	15.78	0.35	0.28	0.34	40.19	7.30	0.47	0.42	9.79	15.76	0.61	0.57	4.66	0.42
2	*Axonopus compresus*	0.65	15.46	17.44	0.44	0.27	0.30	44.97	6.71	0.36	0.38	12.77	16.91	0.53	0.25	5.73	0.33
2	*Eriochloa subglabra*	0.56	11.54	15.84	0.89	0.25	0.24	43.58	4.86	0.50	0.61	11.39	15.71	0.67	0.33	4.33	0.42
4	*Dactyloctenium aegyptium*	0.53	13.44	15.63	1.13	0.27	0.35	44.19	5.54	0.35	0.31	10.6	15.62	0.75	0.29	3.57	0.43
5	*Panicum tryperon*	0.44	14.62	16.09	0.70	0.28	0.28	37.63	5.99	0.37	0.34	7.49	16.82	0.47	0.76	4.61	0.36
6	*Oplismenus burmani*	0.36	18.65	15.46	0.77	0.28	0.40	45.69	4.11	0.39	0.36	13.42	14.74	1.05	0.14	4.48	0.31
7	*Eleusine indica*	0.36	12.05	17.59	0.86	0.31	0.34	47.31	4.33	0.41	0.19	12.87	16.15	0.99	0.43	4.21	0.33
8	*Chloris barbata*	0.36	12.12	17.01	0.69	0.44	0.16	46.85	4.81	0.33	-0.04	9.6	16.12	0.59	0.40	3.72	0.27
9	*Cynodon dactylon*	0.34	14.94	18.09	0.59	0.32	0.37	41.16	4.84	0.37	0.05	8.99	17.14	0.64	0.65	4.23	0.36
10	*Digitaria adscendens*	0.21	11.19	17.50	0.56	0.27	0.32	48.30	4.72	0.32	0.38	12.07	16.27	0.82	0.35	3.98	0.36

Table 1. (continous)

		Rainy Season									Dry season						
			CP	GE	Ca	P	Tanin	ADF				CP	GE	Ca	P		
No	***Forage species***	**SI**	%	MJ/kg	%	%	%	%	WRC	WS	**SI**	%	MJ/kg	%	%	WRC	WS
11	*Panicum eruciforme*	-0.01	12.43	17\.66	0.42	0.31	0.58	48.11	4.24	0.21	0.06	9.16	16.63	0.44	0.22	3.96	0.24
12	*Cyperus haspan*	-0.10	9.81	17.33	0.79	0.21	0.43	49.87	4.43	0.30							
13	*Imperata cylindrica*	-0.22	9.43	18.09	0.26	0.22	0.25	45.36	3.38	0.26	-0.29	7.20	17.03	0.32	0.16	3.57	0.28
14	*Themeda arguerns*	-0.23	7.40	17.33	0.21	0.20	0.34	52.54	3.78	0.23	-0.32	6.49	15.63	0.44	0.08	3.78	0.19
15	*Heteropogon contortus*	-0.28	9.04	17.96	0.46	0.23	0.61	49.52	3.39	0.27							
16	*Eragrostis amabilis*										0.14	9.57	17.39	0.56	0.24	4.71	0.39
17	*Andopogon aciculatus*	-0.29	9.98	17.04	0.75	0.30	0.41	48.02	3.18	0.21	-0.10	6.87	16.07	0.53	0.25	2.77	0.30
18	*Oplismenus composites*	-0.67	11.00	15.44	0.46	0.14	0.35	48.61	3.90	0.23	-0.03	12.67	15.69	0.24	0.15	4.26	0.27
19	*Phragmites* sp.	-0.85	8.47	18.70	0.36	0.26	0.29	51.58	2.72	0.23	-0.11	10.85	17.65	0.24	0.22	3.26	0.20
	Woodys																
1	*Leucaena leucocephala*	0.51	27.65	20.22	1.21	0.27	2.16	27.62	4.74	0.46	0.51	21.28	19.28	1.91	0.23	4.19	0.47
2	*Hibiscus sinensis*	0.44	16.13	17.32	2.22	0.35	0.35	51.26	4.27	0.35	0.47	15.30	17.92	2.36	0.19	4.94	0.38
3	*Grewia koordersiana*	0.33	17.34	19.02	1.33	0.27	0.41	49.67	3.38	0.32	0.39	20.64	18.21	2.19	0.18	4.14	0.37
4	*Streblus asper*	0.17	15.22	15.94	1.82	0.11	0.35	50.45	2.62	0.26	-0.01	16.47	15.13	1.04	0.24	3.23	0.33
5	*Schleichera oleosa*	0.05	14.78	20.10	1.11	0.20	1.11	50.37	3.42	0.29	0.01	11.81	17.98	0.77	0.11	3.05	0.25
6	*Acacia auriculiformis*	0.00	21.14	22.05	0.69	0.10	0.51	64.23	2.39	0.23	0.13	22.79	21.16	0.75	0.11	2.71	0.31
7	*Malvastrum* sp.	-0.24	25.63	18.16	2.18	0.24	0.77	57.48	3.42	0.25	-	-	-	-	-	-	-
8	*Phylanthus emblica*	-0.60	11.97	19.73	0.60	0.07	2.75	41.01	2.42	0.36	-0.45	11.81	17.98	0.77	0.11	2.15	0.34
9	*Sida acuta*	-	-	-	-	-	-	-	-	-	0.53	19.08	16.52	2.43	0.56	3.98	0.33
10	*Bridelia monoica*	-	-	-	-	-	-	-	-	-	0.40	19.46	17.31	2.29	0.16	3.78	0.31
11	*Eupatorium odoratum*	-	-	-	-	-	-	-	-	-	-0.33	24.63	18.66	2.24	0.14	3.19	0.21
12	*Lantana camara*	-	-	-	-	-	-	-	-	-	-0.19	16.76	15.81	1.43	0.22	3.07	0.25
13	*Pluchea indica*	-	-	-	-	-	-	-	-	-	0.48	21.79	19.94	2.18	0.20	3.62	0.45
14	*Gliricedia sepium*	-	-	-	-	-	-	-	-	-	0.32	15.95	14.89	2.47	0.12	3.86	0.55
15	*Zizyphus mauritiana*	-	-	-	-	-	-	-	-	-	0.13	15.95	14.89	2.47	0.12	3.09	0.34
16	*Ipomoea hispida*	-	-	-	-	-	-	-	-	-	0.48	22.33	18.00	1.33	0.58	3.58	0.37

Note: The sign minus (-) in column = plant species exist in the habitat, but not selected ; blank column = species does not exist in the habitat analyzed the shoots /young leaves (the part that still can eaten by deer), both in the rainy and dry seasons. On the other hand, the life of a plant or plant part young / old closely related to the content of its ADF and NDF. In line with Tillman *et al*. (1991) that the plants age or older leaves ADF and NDF content of its increasing or vice versa (positive correlation). Furthermore. if it is associated with the physical properties. especially its ability to hold water (water holding capacity) opposite occurs, ie ADF and NDF plant is negatively correlated with its physical properties (Behgar *et al*., 2009).

Feeding Selection in Relation to the Chemical and Physical Properties of Forage

Feeding selection is influenced by several factors such as chemical feed content (CP, GE, minerals Ca, P, fiber ADF, tannins) and physical properties of forage plants (water regain capasity and water solubility). Results of this study are described with reference to the correlation between chemical factors, physical properties with feeding selection index.

Partial correlation (Pearson correlation) feeding selection with acontent of CP, GE. minerals Ca, mineral P, ADF, water regain capacity, and water solubility of forage plant species showed a significant correlation ($P < 0.05$), while the tannins are less significant correlation ($P > 0.05$).

The crude protein (CP) content of forage species positively contribute to feeding selection ($r = 0.457$; $P < 0.05$) (Table 2), increased CP content has positive effect on the level of selection. These results are in accordance with the feeding selection on sheep in the savannas that the content of CP on the species of forage on woody plants positively correlated with the selection of feed (Basha, 2012). Tixier *et al*. (2008) also found that feeding selection on red deer (*Cervus elaphus*) is positively correlated with protein content of feed on woody plants category in the spring, summer and autumn, and weak correlation to the category of grass plants. Selection relationship with a high protein content fodder grass category occurs in winter.

Water absorption (water regain capacity) contribute positively to the selection of forage ($r = 0.56$; $P < 0.05$). The species of plants that high water regain capacity show high level of selection (including the category of preferred), such as *Commelina benghalensis*, *Tribulus terrestris* and *Desmodium triflorum* (forbs); *Eriochloa ramosa, Axonopus compresus, Eriochloa subglabra*, *Dactyloctenium aegyptium* (graminoids); *Leucaena leucocephal*a and *Hibiscus tiliaceus* (woody plants). The ability to water absorb feed is one of the physical properties of the feed into the quality indicator of forage species, because it deals with digestibility, the higher the water absorption, the better the feed quality also. Results of this study are supported by Suhartati *et al*. (2004) that there is a positive relationship between the water absorption with the digestibility of feed. Behgar *et al*. (2009) also reported that the water absorption (water holding capacity) negatively correlated with the content of plant cell walls (ADF and NDF). This means, the lower the negative value of nutritional (such as ADF, NDF), the higher the water absorption. This relationship also explains that the level of plant feed digestibility (fermentative) higher as well.

Water solubility is positively correlated with the feeding selection ($r = 0.556$; $P < 0.05$) (Table 2). Water solubility of food plants also determine the level of digestibility of the feed. The higher the water solubility species of feed, feed digestibility simplify the process of mechanically through the role of saliva in the mouth. Thus. a very large contribution to the subsequent digestive process, both fermentative digestion in the rumen or in the post rumen hydrolytic. Kismunarto (2007) and Suhartati *et al*. (2004), stated that water solubility also determines the flow rate of feed to the post rumen, the higher the water solubility, the feed passes through the rumen faster.

The content of GE forage plant species showed a negative correlation with the selection of fodder ($r = -0.329$; $P < 0.05$) (Table 2). Physiologically, the selection can be approached from the deer eat eating voluntary aspect (VFI: Voluntary Feed Intake), which according to the Putra (1992) that VFI is affected by the GE content of the feed with a negative correlation. The content of DM was positively correlated with the content of GE feed. The higher DM content of GE feed means also higher. DM content and higher GE quicker to give a sense of satiety in the animal or animals faster fulfillment of energy and nutrients in general.

Minerals calcium (Ca) and phosphorus (P) contributed positively to the feeding selection ($r = 0:336$ and $r = 0:466$; $P < 0.05$) (Table 2). Relation of Ca and P minerals to feeding selection in the wild have not been studied previously. The mineral content is Generally associated with the nutritional quality of forage species. Ceacero *et al*. (2010a) stated that, the deer could selecting mineral content in it's feed and the selection is formed by physiological effort to meet the need for minerals.

ADF contributes negatively to the feeding selection (r = -0.503; P <0.05) (Table 2), increased content of ADF on the species of feed lowers feeding selection. ADF content associated with the feed palatability, the higher ADF means the palatability lower. The higher of ADF content can lower digestibility of feed, mean lower nutritive value of feed. Basha, (2012) and Hanley (1996) stated that the nutritive value of a species of feed determines the feeding selection in the wild herbivores, including deer.

Tannins showed a negative correlation with feeding selection, but weak correlation/non significant (r = -0.235; P > 0.05) (Appendix 1 a). Littlefield *et al*. (2011) and Lopez-Try *et al*. (2007) also found no significant correlation between tannin content with the feeding selection on white-tailed deer. The results showed that the tannin content of plant species on BBNP are at moderate levels (less than 4%), ranging from 0.16 to 2.75%. Cannas (2008) states that the tannins in moderate levels (less than 4%) do not cause negative effects for ruminants. Wheeler & Mochrie (1981) high tannin content can decrease the palatability of a species of feed that can affect the preferences of the type of feed. Some woody plants have tannin that can bind to proteins, thereby reducing the nutritive value of the feed.

Table 2. Correlations

		selectio	CP	GE	Ca	P	ADF	Tannin	WRC	WS
Pearson Correlation	selection	1.000	.457	-.329	.336	.466	-.503	-.235	.560	.556
	CP	.457	1.000	-.143	.592	.371	-.386	.245	-.058	.489
	GE	-.329	-.143	1.000	-.480	-.448	.433	.499	-.283	-.555
	Ca	.336	.592	-.480	1.000	.514	-.414	-.035	-.027	.520
	P	.466	.371	-.448	.514	1.000	-.474	-.306	.182	.523
	ADF	-.503	-.386	.433	-.414	-.474	1.000	-.159	-.450	-.632
	Tannin	-.235	.245	.499	-.035	-.306	-.159	1.000	-.239	.034
	WRC	.560	-.058	-.283	-.027	.182	-.450	-.239	1.000	.177
	WS	.556	.489	-.555	.520	.523	-.632	.034	.177	1.000
Sig. (1-tailed)	selection	.	.003	.025	.023	.002	.001	.084	.000	.000
	CP	.003	.	.203	.000	.013	.010	.075	.369	.001
	GE	.025	.203	.	.002	.003	.004	.001	.047	.000
	Ca	.023	.000	.002	.	.001	.006	.419	.438	.001
	P	.002	.013	.003	.001	.	.002	.035	.144	.001
	ADF	.001	.010	.004	.006	.002	.	.177	.003	.000
	Tannin	.084	.075	.001	.419	.035	.177	.	.081	.423
	WRC	.000	.369	.047	.438	.144	.003	.081	.	.150
	WS	.000	.001	.000	.001	.001	.000	.423	.150	.
N	selection	36	36	36	36	36	36	36	36	36
	CP	36	36	36	36	36	36	36	36	36
	GE	36	36	36	36	36	36	36	36	36
	Ca	36	36	36	36	36	36	36	36	36
	P	36	36	36	36	36	36	36	36	36
	ADF	36	36	36	36	36	36	36	36	36
	Tannin	36	36	36	36	36	36	36	36	36
	WRC	36	36	36	36	36	36	36	36	36
	WS	36	36	36	36	36	36	36	36	36

In this study, some plants such as *Phylanthus Emblica*, *Leucaena leocochepala* and *Schleicera oleosa* which is species of plant that is eaten by the timor deer in BBNP, contain tannins which are relatively higher than other species, namely 2.75%, 2.16% and 1.11% respectly. Holechek (1984) states that the deer is one of the herbivores that have a smaller mouth parts which can be selectively utilize these plants with highly efficient, so that deer can minimize the concentration of tannins that enter the body. Nolte *et al*. (2004) stated that deer have the ability to eat plants that contain tannins, due to the mouth produces saliva proteins capable of binding tannins and minimize the damaging effects of tannins on the digestibility.

Results of regression correlation test (stepwise method) between the feeding selection with the content of the CP, GE, Ca, P, ADF, tannins, water absorption and water solubility of forage species, it feeding selection showed a significant regression correlation with four predictor variables. Four variables are water regain capacity (X_1), the content of CP (X_2), water solubility (X_3) and the content of tannins (X_4). Regression model of feeding Selection with four predictor variables are as follows: $\mathbf{Y = -2.31 + 0.14X_1 + 0.04X_2 + 1.99X_3 - 0.12X_4}$ (Table 3). With R determinant coefficient value (R^2) is 0.706, meaning that jointly four factors (water regain capacity, content of CP, water solubility and tannin content influential of 70.6% against the selection forage plant species in the habitat, and the remainder was due to other factors.

Table 3. Model Summary

Model	R	R Square	Adjuste d R	Std. Error of the	Change Statistics				
					R Square	F Change	df1	df2	Sig. F
1	.560[a]	.313	.293	.33624	.313	15.502	1	34	.000
2	.744[b]	.553	.526	.27518	.240	17.762	1	33	.000
3	.785[c]	.616	.580	.25917	.062	5.202	1	32	.029
4	.814[d]	.662	.619	.24685	.047	4.274	1	31	.047
5	.840[e]	.706	.657	.23423	.043	4.432	1	30	.044

1. Predictors: (Constant), WRC; 2. Predictors: (Constant), WRC, CP; 3. Predictors: (Constant), WRC, CP, WS; 4. Predictors: (Constant), WRC, CP, WS, Tannin; 5. Predictors: (Constant), WRC, CP, WS, Tannin, GE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-.506	.182		-2.782	.009					
	WRC	.158	.040	.560	3.937	.000	.560	.560	.560	1.000	1.000
2	(Constant)	-	.212		-5.386	.000					
	WRC	.166	.033	.588	5.046	.000	.560	.660	.587	.997	1.003
	CP	.044	.010	.491	4.215	.000	.457	.592	.490	.997	1.003
3	(Constant)	-1.327	.216		-6.157	.000					
	WRC	.149	.032	.527	4.668	.000	.560	.636	.511	.941	1.063
	CP	.031	.011	.343	2.693	.011	.457	.430	.295	.739	1.353
	WS	1.266	.555	.295	2.281	.029	.556	.374	.250	.718	1.393
4	(Constant)	-1.069	.240		-4.452	.000					
	WRC	.135	.031	.478	4.342	.000	.560	.615	.453	.898	1.114
	CP	.036	.011	.403	3.228	.003	.457	.502	.337	.700	1.429
	WS	1.212	.529	.282	2.288	.029	.556	.380	.239	.716	1.396
	Tannin	-.068	.033	-.229	-2.067	.047	-.235	-.348	-	.887	1.127

5	(Constant)	- 2.311	.632		-3.655	.001					
	WRC	.141	.030	.499	4.751	.000	.560	.655	.470	.890	1.124
	CP	.036	.011	.400	3.383	.002	.457	.526	.335	.700	1.430
	WS	1.990	.624	.463	3.190	.003	.556	.503	.316	.465	2.152
	Tannin	-.116	.039	-.390	-3.000	.005	-.235	-.480	-	.580	1.724
	GE	.000	.000	.321	2.105	.044	-.329	.359	.208	.420	2.378

a. Dependent variable: selection index

Selection of forage plants on deer in the wild is a complex behavior and a consequence of interactions among several factors. Selection of the species of feed on deer involves several factors, such as nutritional value, alelokimia compound (negative value), the physical properties of the plant itself, the availability in habitat and also for competitors or predators. Likewise. olfactory and taste organs of animals may be used to determiner chemical compound or nutrient which is essential for life. Given the social learning process, learning from the mother and the process of evolution has formed a feeding selection behavior in animals in nature (Ceacero *et al*.. 2010b; Hanley,1997; Moser *et al*.. 2006).

Conclusion

Feeding selection of forage plants in the timor deer are influenced by the chemical (content of CP, GE, ADF) and physical properties (water regain capacity and water solubility) species of forage plants. Feeding selection increases with an increase in protein content, calcium content, the value of water regain capacity and water solubility of forage species. The content of CP and tannins (chemical properties), water regain capacity and water solubility (physical properties) of forage plants species can be a predictor variables to predict the feeding selection of forage plants in the habitat, with the regression model are as follows: $Y = -2.31 + 0.14X_1 + 0.04X_2 + 1.99X_3 -0.12X_4$ (X_1 = content of CP; X_2 = water regain capacity; X_3 = water solubility; and X_4 = content of tannin; $R^2 = 0.706$; $P < 0.05$).

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