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Nutrient content and *in vitro* digestibility of rejected red seaweed (*Eucheuma cottonii*) from different origin

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ABSTRACT: The nutrient content and in vitro digestibilty of rejected red seaweed (*Eucheuma cottonii*) from three different origin locations (regions), Alor, Ambon, and Rote was studied. Rejected seaweed *Eucheuma cottoni* was obtained from an agar factory located in west kupang subdistrict, Kupang regency, NTT province, Indonesia. Proximate analysis, fiber analysis (NDF, ADF, cellulose, hemicellulose, lignin, silica), mineral analysis (Ca, Mg, Fe, and S) as well as *in vitro* digestibility (dry matter, organic matter, crude protein, crude fat, crude fiber, NDF, ADF, and lignin) had been studied. Seaweed's growth location influenced chemical composition and digestibility. *In vitro* digestibility of crude protein, crude fat, crude fiber, NDF, ADF, and lignin of rejected *Eucheuma cottoni* from Ambon was higher ($p<0.01$) than that of rejected *Eucheuma cottoni* from Alor and Rote. Crude protein and nitrogen free extract content of rejected *Eucheuma cottoni* from Ambon were also high compared with that of rejected *Eucheuma cottoni* from Alor and Rote. It is concluded that rejected *Eucheuma cottoni* from Ambon is better to be used as carbohydrate source feed in calf starter.

Keywords: Calf, *Eucheuma cottoni*, *in vitro* digestibility, nutritive value, seaweed.

INTRODUCTION

The scarcity of the good quality feed during dry season is main factor causes low productivity of ruminant animals such as Bali cattle in East Nusa Tenggara (NTT) province (Bamualim, 1988; Tiba, 2010). Dahlanuddin et al. (2010) reported reducing of the body weight in almost all ages during dry season. Tiba (2010) reported that death rate of calf in NTT province was still high which could reach 37%.

The improvement of ruminant animal's productivity especially Bali cattle has been conducted by providing concentrate either to calves (Belli, 2002) or both calves and their mother (Tiba, 2010). Jelantik et al. (2010) reported that providing concentrate on calf reduced calf's death rate and increased daily body weight. Concentrate consisting of fish meal, rice brand, and corn meal was difficult to be adopted by local farmers because of the price.

Utilisation of certain legumes such as *Clitoria ternatea* in the complete feed had been conducted to substitute concentrate. *Clitoria ternatea* forage harvested at vegetative stage contained crude protein of 16 to 18%, gross energy of 18.6 MJ/kg, organic matter digestion of 69.7%, and metabolic energy in ruminant animal of 12.4 MJ/kg (Jelantik et al., 2015). However, the availability of the legume during dry season was limited so there was need for other high-quality feed which its availability during dry season. Several species seaweed could be used as part of the complete feed because of their high availability during dry season. Ventura and Castanon (1998) reported seaweed production could reach 100 ton dry matter/ha/year.

Seaweed species *Eucheuma cottoni* is a seaweed very often be cultured and have rapidly growth characteristic and also resist temperature and salinity change. This seaweed could be used as animal feed. Naiulu (2016) used seaweed species *Ulva lactuca* as cattle feed. Rejected *Eucheuma cottoni* from a jelly factory located in West Kupang subdistrict, Kupang regency, East Nusa Tenggara province of Indonesia could be used as animal feed. The seaweed originated from several areas in Indonesia. Chemical composition and digestibility of seaweed were influenced by location it was originated (Galland-Irmouli et al., 1999). The nutritive value of

rejected *E. cottonii* in Kupang regency of Indonesia has not been evaluated. Thus, this study was conducted to compare nutritive value and nutritive degradation rate of rejected *Eucheuma cottoni* based on the origin location of the seaweed.

MATERIALS AND METHODS

Rejected seaweed *Eucheuma cottoni* from Ambon (in Maluku province), Alor and Rote (East Nusa Tenggara Province) were used in this study. Rejected seaweed were washed and grind to 2 mm size to be used. Dry matter, ash, crude protein, crude fat, and crude fiber were determined according to standard method (AOAC, 1990). Neutral detergent fiber (NDF), acid detergent fiber (ADF), hemicellulose, cellulose, and lignin were determined according to Van Soest et al. (1991). ANKOM technology with filter bag technique was applied. Samples from each region were washed, dried, and grinded to pass through a 2 mm screen. Mineral contents Ca, Mg, Fe, and S were determined by using spectrophotometry. Digestibility of dry matter, organic matter, crude protein, crude fat, crude fiber, NDF, and ADF was determined according to Tilley and Terry method (Tilley and Terry, 1963). The design used to test the digestibility was completely randomized design with three treatments and three replications. The treatments were seaweed origin, Ambon, Alor and Rote. The obtained data were tabulated and analyzed according to analysis of variance (ANOVA) and Duncan multiple range test (Gaspersz, 1995; Gomez and Gomez, 1976). Data analyzed used SPSS 18 program.

RESULTS AND DISCUSSION

Chemical composition

Chemical composition of a feed would determine nutritive value of the feed. Feed containing high crude protein and low crude fiber would have higher nutritive value than that containing low crude protein and high crude fiber. Chemical composition of *Eucheuma cottoni* from three locations, Ambon, Alor and Rote could be seen in Table 1.

There was a chemical composition variation of *Eucheuma cottoni* because of the different growth location. Seaweed chemical composition was influenced by several factors such as species, location (place), and season (Galland-Irmouli et al., 1999). Crude protein content of seaweed *Ulva lactuca* ranged between 8 to 15.3% (Hind et al., 2014) whereas crude protein content of *Eucheuma cottoni* in this study ranged between 4.14 to 5.34%. Galland-Irmouli et al. (1999) said that the differences may be caused by environmental condition variation such as light intensity.

Mineral content, Ca, Mg, Fe, and S of *Eucheuma cottoni* from three locations, Ambon, Alor and Rote could be seen in Table 2. Based on the results shown in Table 2, it could be said that *Eucheuma cottoni* contained macro minerals, Ca, Mg, Fe, and S, that are relatively high. Mineral content Ca of *Eucheuma cottoni* (1.79 to 3.38%) relatively higher than that of *Oplismenus burmanni* grass of only 0.28% (Mansyur et al., 2006). Mineral content of *Eucheuma cottoni* also varied between locations (Table 2).

Nutritive *in vitro* digestibility

Nutritive digestion determined nutritive value of a feed. Higher nutritive digestion indicates higher nutritive value. Nutritive *in vitro* digestion of *Eucheuma cottoni* could be seen in Table 3. Dry matter *in vitro* digestion of *Eucheuma cottoni* from Alor, Ambon and Rote ranged between 89 to 93% while its organic matter digestion was between 35 to 49% (Table 3). In Sacco, digestion of dry matter and organic matter of *Ulva lactuca* was 46.9 and 40.6%, respectively (Ventura and Castanon, 1998). It indicated that dry matter digestion of *Eucheuma cottoni* was higher enough compared with dry matter digestion of *U. lactuca,* however, organic matter digestion of both was not so much different.

Statistical result test indicated that location significantly influenced ($p<0.01$) *in vitro* dry matter and organic matter digestion (Table 3). Location would influence seaweed chemical composition and then its nutritive digestion. Lobban et al. (1985) indicated that seaweed chemical composition was influenced by location and season. Digestion was influenced by several things such as chemical composition (McDonald et al., 1994).

Duncan multiple range test indicated that dry matter and organic matter *in vitro* digestion of *Eucheuma cottoni* from Alor were higher than that of *Eucheuma cottoni* from Ambon and Rote ($p<0.05$) (Table 3). Silica and crude fiber content of *Eucheuma cottoni* from Alor were lower than that of *Eucheuma cottoni* from Ambon and Rote (Table 1). Higher silica, cellulose, and crude fiber content would reduce digestion of feed.

Crude protein *in vitro* digestion of *Eucheuma cottoni* from Alor, Ambon and Rote ranged between 40 to 50 % (Table 3). Crude protein *in vitro* digestion of *U. lactuca* was 45.7% (Ventura and Castanon, 1998). This indicated that crude protein digestion of *Eucheuma cottoni* from certain locations (Alor and Rote) was lower than that of *U. lactuca,* however, crude protein digestion of *Eucheuma cottoni* from another location (Ambon) was higher than that of *U. lactuca*. Seaweed species and its original location influenced chemical composition (Galland-Irmouli et al., 1999). The digestion of crude fat, crude fiber, NDF, ADF, and lignin also variated between location (Table 3).

Statistical result test indicated that location very significantly influenced ($p<0.01$) *in vitro* digestion of crude protein, crude fat, crude fiber, NDF, ADF, and lignin of *Eucheuma cottoni* (Table 3). Chemical composition of a feed influenced the digestion of the feed (McDonald et al.,

Table 1. Chemical composition of *Eucheuma cottoni* based on location.

Location	DM	Ash	CP	CF	Cfat	NFE	NDF	ADF	Hemi selelulo	Selulosa	lignin	silica
Ambon	97.64	86.73	5.23	3.22	0.74	1.72	3.21	2.34	0.87	1.09	0.82	0.43
Alor	97.10	86.80	4.14	3.05	2.67	0.44	3.40	2.62	1.38	1.07	0.90	0.05
Rote	97.05	84.67	5.34	3.77	3.21	0.06	6.12	3.32	2.80	1.15	0.83	1.28

DM: Dry matter; CP: crude protein; CF: crude fiber; Cfat: crude fat; NFE: nitrogen free extract; NDF: neutral detergent fiber; ADF: acid detergent fiber.

Table 2. Mineral content of *Eucheuma cottoni* based on location.

Location	Mineral (%)			
	Ca	Mg	Fe	S
Alor	3.382	0.197	0.040	1.601
Ambon	2.229	0.204	0.020	2.027
Rote	1.786	0.159	0.093	1.272

Table 3. Nutritive in vitro digestibility of *Eucheuma cottoni* from Alor, Ambon, and Rote.

Location	Digestibility (%)							
	BK	BO	PK	LK	SK	NDF	ADF	Lignin
Alor	93.25^{a}	48.56^{a}	44.23^{b}	43.08^{b}	23.41^{c}	20.57^{c}	22.51^{c}	20.63^{b}
Ambon	92.33^{b}	34.52^{b}	50.46^{a}	54.02^{a}	67.69^{a}	49.00^{a}	52.65^{a}	45.40^{a}
Rote	88.98^{c}	34.87^{b}	40.17^{c}	38.02^{c}	42.81^{b}	36.89^{b}	39.54^{b}	20.32^{b}

Different superscript on the same column indicated there were significantly different ($p<0.05$).

1994). Feed containing lower lignin, hemicellulose, NDF, and ADF content often have higher digestion of the nutritive than that containing higher lignin, hemicellulose, NDF and ADF content. Besides, certain mineral namely S also influenced feed digestion.

Duncan multiple range test indicated that *in vitro* digestion of crude protein, crude fat, crude fiber, NDF, ADF, and lignin of *Eucheuma cottoni* from Ambon was higher than that of *Eucheuma cottoni* from Alor and Rote (Table 3). However, nutritive *in vitro* digestion of *Eucheuma cottoni* from Alor and Rote varied. Crude protein and crude fat *in vitro* digestion of *Eucheuma cottoni* from Alor were higher than that from Rote but *in vitro* digestion of crude fiber, NDF, and ADF of *Eucheuma cottoni* from Rote was higher than that from Alor. On the other hand, lignin *in vitro* digestion was the same for *Eucheuma cottoni* from Alor and Rote (Table 3). Chemical composition of a feed influenced the digestion of the feed (McDonald et al., 1994).

Conclusion

It was concluded that nutritive value of *Eucheuma cottoni* from Ambon was better than that from Alor and Rote. It was suggested that rejected *Eucheuma cottoni* from Ambon should better be used as feed in calf starter ration.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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