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The Effect of Flushing Premating with Spirulina Platensis Supplementation on Ewes Postpartum Estrus

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ABSTRACT

Lactating ewes require high nutrients for basic life requirements and milk production. If not fulfilled, it can have an impact on Negative Energy Balance (NEB) that reduces body weight, Body Condition Score (BCS), and extend the appearance of Postpartum Estrus (PPE). Premating flushing feed is an effort to improve ewe nutrients by adding high nutrition for preparation before mating so that after lambing and suckling, the ewe immediately estrus. This research aimed to evaluate the performance of ewes through premating flushing feeding. The research was conducted at Mendo Galak Farm, Sleman, Yogyakarta. Twenty ewes 2-3 years old with BCS 2-3 divided into two groups; the group with flushing treatment consisted of dried water spinach (Ipomoea reptans poir), concentrate feed with Spirulina sp. (14,92% crude protein, 60,28% total digestible nutrients), and the control group (PS) without Spirulina sp. (crude protein 11,82%, total digestible nutrients 53,20%). Flushing feed was given after a month postpartum as much as 3% dry matter of body weight. The recorded parameter was daily feed consumption, monthly body weight, BCS, and postpartum estrus. The data obtained were tested by an independent T-test with Statistical Product and Service Solution (SPPS ver. 22). The results showed the consumption and digestibility of CP, TDN, and ewe's ADG had a significant difference ($P<0.05$). Postpartum estrus (PPE) of flushed ewes had no significant difference ($P>0.05$), 73.90±11.55 vs. 77.60±14.65 days, respectively. The conclusion was that flushing premating treatment with the addition of Spirulina platensis increased the nutrient intake and digestibility of CP, TDN, and ADG but had not shortened on postpartum estrus of lactating ewes.

Keywords: Flushing premating, Spirulina sp., Body weight, BCS, Postpartum estrus

Introduction

Sheep is one of the meat-producing commodities that is widely bred. It has the prolific potential of having more than one lamb on a period, and the lambing interval is relatively shorter than cows. Farmers have carried out most breeding efforts in rural areas; the feed given to the ewe at various physiological phases did not differ, whereas the requirement was different. Theoretically, the nutrient for lactating ewes is higher to fulfill the essential metabolic nutrient and complete the nutrient needed for milk production. If the feed given is the same as that of maintenance ewe, it does not fulfill the requirement, and a Negative Energy Balance can occur. Nutritional adequacy in the lactation phase is crucial to maintain the Body Condition Score (BCS); thin ewes increase the chance of silent heat so that it directly affects the appearance of Post Partum Estrus (PPE) (Ashari *et al.* , 2018). If the nutritional requirement of the ewe is insufficient for the early lactation period caused by feed intake of postpartum ewes are slower than the energy production needed to produce milk, the body fat and muscle tissue are mobilized as the body's adaptation to physiological conditions prioritized for milk production (Gross *et al.* , 2011). The mobilization of energy and body fat for milk production reduces ewes body weight and disrupts the hormonal cycle for the occurrence of estrus. Negative Energy Balance during the early 30 days of lactation will be prolonging the PPE cycle (Butler, 2001). The solution for the problem of premating ewes due to NEB is flushing.Flushing in ewe is a technique to increase nutrient intake for increas ovulation rate. Flushing that improves the condition of the ewe’s body through feed improvement in the reproductive process optimizes the production and reproductive performance. According to (Shad *et al.* , 2011) the bodyweight of ewes with the flushing method increased at 3-4 weeks before mating, had more potential for pregnancy than thin ewes without flushing.

Flushing in ewe is a technique to increase nutrient intake to improve ovulation rate. Flushing that improves the condition of the ewe's body through feed improvement in the reproductive process optimizes the production and reproductive performance. According to Shad *et al.* (2011), the bodyweight of ewes with the flushing increased at 3-4 weeks before mating, had more potential for pregnancy than thin ewes without flushing. Various studies have shown that reproductive performance increases with body weight gain during the flushing period. The addition of protein and energy sources of feed affects the mechanism of the ovulation rate (Daghigh *et al.*, 2016). Increasing protein levels in concentrate with Spirulina sp. supplementation, which has a protein content of 65%, accelerates the increase in body weight of the ewes during the lactation period. Spirulina sp. can be a source of feed protein because it has a mucoprotein cell wall that is easily digested (Henrikson, 2010). Spirulina sp. as flushing feed for ewes to increase body weight and performance of sheep in intensive rearing in conditions of smallholder farmers has never been studied. The purpose of this study was to evaluate the performance of ewes through premating flushing feeding with the addition of Spirulina platensis. The ewes performance includes changes in body weight, BCS, and reproductive performance.

Materials and Methods

Twenty ewes of DET-Garut breed 2-3 years in a condition after one month of lambing. Ewes were kept in cages that were individually insulated with 1x1.1 m2, equipped with feeding and drinking places. The ewes were divided into two groups; 10 ewes with lower body weight were put into the treatment group (PF) and the rest into the control group (PS).

The ewes were fed 3% of body weight (dry matter basis) with a proportion of 50% dry water spinach (*Ipomoea reptans poir*) and 50% concentrate KJUB Puspetasari F31. The ewes in the treatment group were given the same feed as the control group. The concentrate was added by additive Spirulina platensis 10 g/head/day. The nutrient content of the feed is shown in Table 1. Feeding was twice a day at 07.00 AM and 03.00 PM and drinking water ad-libitum.

The data observed included feed consumption and digestibility, ADG, BCS, and PPE of ewes. Feed consumption was calculated from the total of feed given minus the remaining feed. Digestibility was determined based on the total feed intake (in DM) minus feces (in DM) and digested nutrients. The nutrient consumption and digestibility measured were dry matter, crude protein, and total digestible nutrients (TDN). ADG was obtained from weighing carried out before and after the feed treatment, in the morning before the ewes were fed, then the final weight was reduced by the initial weight divided by the time of maintenance. Assessment of BCS with a scale of 1 (thin) – 5 (obesity) using visual and palpability methods, before and after the feed treatment that refers to Thompson and Meyer (2006).

Observation of estrus was carried out with the help of a ram given an animal coloring marker on the lower chest to mark the occurrence of mating. The marker imprinted a color mark at the tail head and the outer vulva of ewes. In addition, the onset of estrus symptoms can be seen visually with the behavior of letting the back of the ewe be sniffed, not refusing to be climbed, followed by copulation.

The research data obtained were analyzed descriptively with an independent T-test with Statistical Product and Service Solution (SPSS ver. 22).

Results and Discussion

Nutrient intake

The feed consumption data of ewes are shown in Table 2. The average consumption of DM, CP, and TDN of ewes between treatments was significantly different ($P<0.05$). The supplementation with Spirulina sp. effect on ewe consumption. According to Khotijah *et al.* (2020), DM consumption between the same groups showed that the addition of raw materials did not influence the ration palatability.

Crude protein consumption is affected by Spirulina sp. as a protein source. Protein utilization was also associated with low body weight and in the NEB state to recover ewes after lambing and lactation. The nutritional requirements of the ewes are higher at the end of pregnancy and the early onto the third week of lactation (Joy *et al.*, 2014), but at the same time,

Table 1. Nutrient content of treatment feed

Nutrient content (%)	Group	
	Control	Flushing
*Water content	86.94	95.35
**Crude protein	11.82	14.92
*Crude fiber	19.72	18.90
*Crude fat	3.62	3.24
*Ash	11.31	11.04
***Total digestible nutrient	53.20	60.28

*Result of forage and pasture science laboratory, Animal Science UGM; **Result of BPMSP, Agriculture Ministry; ***Result based on Hartadi *et al.* (1980) formulation.

Table 2. Nutrient consumption

Variables	Treatments	
	Control	Flushing
Dry matter (g/bb^0.75/d)	113.66±25.23	134.34±17.66
Crude protein (g/bb^0.75/d)	13.50±3.22[a]	20.00±2.52[b]
Total digestible nutrient (g/bb^0.75/d)	60.47±13.42[a]	80.98±10.65[b]

[a,b] Different superscript at the row indicates siginifcance difference (P<0.05).

Table 3. Nutrient digestibility

Variables	Treatments	
	Control	Flushing
Dry matter (%)	59.73±6.94	61.40±4.16
Crude Protein (%)	54.88±7.48[a]	65.76±4.89[b]
Total digestible nutrient (%)	31.78±3.69[a]	37.01±2.50[b]

[a,b] Different superscript at the row indicates siginifcance difference (P<0.05).

the ability to consume feed decreases that limited nutrient availability. TDN was an illustration of the total energy derived from feed consumption. The averages of TDN consumption in the control and flushing treatments were 649.83±109.69 and 789.71±96.01 g/head/day, respectively. Consumption of TDN treatment was in beneath with the ewes basal requirement in the flushing phase of 940 g or 55% (NRC, 2007).

The digestibility of the ration was measured to determine the number of nutrients absorbed by the ewes. Suardin *et al.* (2014) stated that digestibility is an indicator of ration quality; a high DM digestibility indicates a high digestibility value of feed ingredients. The results showed that the DM between treatments showed no significant difference (P>0.05) (Table 3). It showed that there were the same nutrient supplies for rumen microbial growth. The DM digestibility was in line with the dry matter consumption that also showed no differences (Ratu *et al.* , 2020).

Table 3 shows that CP and TDN digestibility of flushing treatment were significantly different (P<0.05). Supplementation of protein feed sources and the increase of TDN levels increased the digestibility in the feed. According to Mathius *et al.* (2003), the different digestibility coefficients in the availability can be more absorbed. The higher the protein content of the ration, the higher the digested CP level. The role of Spirulina in CP digestibility by ewe was due to bypassing degradation in the rumen. Gouveia *et al.* (2008) reported that Spirulina increased the rumen microbial CP production and reduced retention time in rumen. Approximately 20% of Spirulina feed had bypassed rumen degradation. Spirulina sp. has a high Protein Efficiency Ratio (PER) (Borowitzka and Borowitzka, 1988). The cell walls were made of mucoproteins, polysaccharides, and the enzyme superoxide dismutase (SOD), which was an intercellular antioxidant with an activity of 10,000 - 37,500 u/10g Spirulina sp. and it does not have cellulose, so it was easier to digest and absorb by the body (Henrikson, 2010).

Significant differences in TDN digestibility were followed by an increase in TDN consumption in the ratio to balance protein levels as a stimulant for rumen microbial growth. Supplementation of protein sources cannot stimulate rumen microbial growth without supplementation of dissolved carbohydrates (Parakkasi, 1999). Klein (2020) added that synchronizing glucose availability from carbohydrates as energy and peptides in the form of nitrogen protein in the rumen increases microbial activity and rumen microbial protein synthesis. Freer and Dove (2002) mention a central sensor-integrator that processes complex metabolic information about nutritional status and translates into reproductive responses. Added by Sargison *et al.* (2018), follicular development was controlled by hormones, leptin which was influenced by body fat levels, increasing glucose and insulin during the late luteal phase to increase the number of follicles ovulated.

Ewes performance

The ewes performance, such as body weight and ADG during treatment, was presented in Table 4. Flushing treatment significantly affected ewes ADG within a month of treatment (P<0.05). Bodyweight and ADG have a positive correlation indicating the fulfillment of the basal requirement of the ewe during lactation. Bodyweight gain in a month of treatment of flushing group was increased by 2.2 kg, heavier than the control group 1.36 kg, with ADG of the flushing ewe 96.174±23.72 and control 44.80±9.17 g/head/day. This result was similar to Karikari and Blasu (2009), the bodyweight of the flushing ewe increased by 2 kg, and ADG was 40.80±4.97 g/head/day, after six weeks of flushing. Adding 10% of Spirulina increased bodyweight with ADG 200 g/head/day compared

Table 4. Bodyweight and average daily gain of ewes

Variables	Treatments	
	Control	Flushing
Bodyweight 1 month (kg)	23.98±5.81	19.88±2.61
Bodyweight 2 months (kg)	25.34±5.62[b]	22.08±2.31[a]
ADG (g/d)	44.80±9.17[a]	96.17±23.72[b]

[a,b] Different superscript at the row indicates significance difference (P<0.05).

Table 5. Body condition score of ewes

Variables	Treatments	
	Control	Flushing
BCS 1 month	2.90±0.21[a]	2.55±0.28[b]
BCS 2 months	2.90±0.21	2.70±0.26

[a,b] Different superscript at the row indicates significance difference (P<0.05).

Table 6. Postpartum estrus of ewes

Variables	Treatments	
	Control	Flushing
PPE	77.60±14.65[ns]	75.90±11.55[ns]

[Ns] Non Significan.

to the control and 20% Spirulina treatment in the ratio (Holman *et al.*, 2013). The increase in body weight indicates that the nutrients consumed by ewes have fulfilled their basal nutrient requirement and were also partially used for reproductive organ growth (Freer and Dove, 2002).

The difference in BCS of ewes before treatment showed significant results (P<0.05). It indicates that ewes during the first month of lactation after lambing decreased BCS because the ewe's nutrient consumption had not sufficient the growth of muscle mass and fat reserves. In addition to fulfilling the basal nutrient requirement, the ewe needed more energy for milk production. Barbato *et al.* (2021) stated that feed supplements did not affect the increase in BCS and hormones, and at least the supplementation had protected the ewe from the decrease in BCS commonly associated with lactation. On the other hand, higher milk production encourages more feed consumption. Holman *et al.* (2013) have another opinion that Spirulina sp. contains the essential amino acid ɣ-linolenic which is stored subcutaneously in the form of triacylglycerol in adipose tissue. With the addition of Spirulina sp., BCS of the control group was 2.90±0.21 and 2.70±0.26 at weaning, still below the recommended range from Thompson and Meyer (2006) that BCS was 3.0-3.5 for ewes suckling single and 3.5-4.0 suckling twins, it for milk production and composition, as well as for optimal reproductive performance.

According to Sutiyono *et al.* (2010), the average time interval for the emergence of PPE was 2.84-3.44 months. The results of this study were slightly shorter PPE, 2.58±0.48 months for the control and 2.46±0.38 months for the flushing ewes. Fuquay *et al.* (2011) reported that the onset of PPE was strongly influenced by uterine involution. The ewes enter the postpartum anestrus period takes 6-8 weeks before the uterus recovers after lambing, the ovaries resume their normal activities, and the ewe can be mating again. Several factors influencing the PPE period include the breeding season, nutritional status, and lactation.

The flushing ewes had a faster estrus period than the control, but statistically no significant difference. The faster PPE possibly be affected by the provision of good nutrients improved the nutritional status of ewes to reproduce optimally. El-Shahat and El Maaty (2010) reported a significant interaction between nutrient intake and BCS. Supplementation in ewe increase BCS making normal reproductive cycle. The research conducted showed the impact of 3 weeks of feed supplementation on the ovarian activity of ewes. The number of medium-sized (>3-5 mm) and large (>5 mm) follicles by ultrasonography showed an increase compared to control (Scaramuzzi *et al.*, 2006).

Supplementation with Spirulina sp. affected omega-6 as a precursor to steroid hormones in the blood, such as estrogen, impacting the reproductive cycle. Kabinawa (2014) reported that Spirulina sp. contains 24.9% GLA (Gamma Linoleic Acid) or omega-6 as a precursor stimulating the hormone prostaglandin. The ratio of omega-3 and omega-6 fatty acids increases blood cholesterol levels, which are precursors for the formation of reproductive hormones for steroid hormones such as estrogen have an essential role in the occurrence onset of estrus (Pujiawati *et al.* , 2018).

Conclusions

Flushing premating treatment with Spirulina platensis increased the CP and TDN intake and average daily gain but did not shorten postpartum estrus of lactating ewes with intensive systems.

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