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Research Article
Reproductive Profile of Etawah Crossbred Does Fed Flushing Diet Containing Different Kinds of Plant Oil and Animal Fat

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Abstract

Background and Objective: Reproduction system is affected by nutrient status of the animal. Flushing is one of reproduction program where the animal should give good quality diet. This study was aimed to evaluate etawah crossbred does reproduction performance giving flushing diet with different fat sources. The fat of plant oils are sunflower and flaxseed and from animal oils are tallow and *Lemuru* fish. **Materials and Methods:** Twenty four of Etawah crossbred does (average body weight 33.83±3.70 kg) were used in this experiment by using completely randomized block design. There are four treatments with four animals of each treatment. The treatments were flushing diet containing 5% sunflower oil (R1), 5.2% flaxseed oil (R2), 5.3% tallow (R3) and 5% *Lemuru* fish oil (R4). Treatment was given three weeks before and two weeks after matting, following 2 weeks before partus. During pregnant, the does were given basal diet (ratio concentrate:napier grass was 70:30). Body condition score, nutrient status, blood metabolite and hormone and also performance reproduction were evaluated. **Results:** The nutrient consumption was same in all treatment. Blood glucose were same in all treatments but the highest blood cholesterol was in R3 during estrus and in R4 during mid gestation. The highest plasma estradiol was in R1 during early gestation, while the highest plasma progesterone was in R2 during late gestation. Litter size and birth weight were same in all treatment, while the highest total embryo was in R2 treatment. **Conclusion:** It is concluded that flaxseed oil for flushing diet was significantly increased number of total embryo.

Key words: Basal diet, body condition score, flaxseed, tallow, sunflower

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Reproductive performance of animal can be improved by giving flushing diet in order to maintain the steroid hormones and nutrients requirements. The production of small ruminant is not only depend on the live body weight, body condition score (BCS), but most important is a balance of feeding regimes introduce to the animals. In addition, the nutritional status able to alter hormonal concentrations, thus control reproductive performance of livestock. The evaluation of reproductive performance and nutrient intake with different fat sources have been observed in all stages of small ruminant. Therefore, it is highlighted that nutrient intakes in short period as a flushing diet prior or after mating of ewes could improve BCS, ovulation, percentage of pregnancy and kidding rates. Ewes supplemented with high energy ration of poly unsaturated fatty acid (PUFA) from sunflower oil before and during pregnant increased litter size and the numbers of male kids[1]. It is widely accepted practice in sheep husbandry to provide ewes with extra energy supply (flushing) for 2-3 weeks prior to and during breeding, for the purpose of increasing the number of lambs produced. Ewes and dam with good BCS not really need to give flushing treatment before matting. The level of protein/energy ratio in the ration gave direct affect to blood metabolites parameters of pregnant ewes which could support nutrient supply to the embryo[2]. Energy source for good ration could be from fat (PUFA) and soluble carbohydrate. Linoleic acid (omega-6, PUFA) is one of concern to improve reproduction on livestock, especially at pregnant condition. Linoleic acid (n-6,18:02) is metabolized to arachidonic acid (n-6, 20:04) as a precursor of type 2 prostaglandin (PGE2)[3]. Flaxseed oil contain high linolenic acid, meanwhile the *Lemuru* fish oil contain high Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA)[4]. Standard type sunflower oil is made up of about 15% saturated and 85% unsaturated fatty acids such as 14-43% of oleic acid and 44-75% of linoleic acids[5]. Treatment flushing diet on ewes by using different fat supplements (rich in omega-3) and (rich in omega-6) showed it could increased medium and large follicles, reproductive hormones and metabolites which contribute into improved fertility rate, lambing percent and reproductive performance[6]. It is very rare information regarding the reproduction data of small ruminant in tropical Southeast Asia with and without flushing management before and after matting by using different kinds of fat. Due to the confined information available regarding to the flushing treatment using different oil sources, this research was carried out in order to evaluate effects of different fat sources as plant oil (sunflower and flaxseed) and animal oil (tallow and *Lemuru* fish) on reproductive performance of etawah crossbred doe.

MATERIALS AND METHODS

Animals experimental setup: The study was carried out at the Department Nutrition and Feed Technology, Faculty of Animal Science, IPB University Indonesia, start from June, 2018 until March, 2019. This research has been got Ethical approval by Animal Care and Used Committe (ACUC) of IPB University Bogor, Indonesia with ACUC number: 119-2019/IPB. Twenty four Etawah crossbred does with average body weight 33.83±3.70 kg (second lactation) and initial BCS around 1.92±0.24 were used in this study. The animals than were divided into four treatment groups with 5 animals for each treatment. The BCS was evaluated by hold in the back, head tail and rib of doe with score range 1 (extremely thin), 2 (thin), 3 (medium), 4 (fat) and 5 (obese). Throughout the study, the does were fed total mixed ration at the level of 3.5% dry matter of total body weight, four times daily, start from 07.00 am and 13.00 pm fed basal concentrate/flushing diet; and at 08.00 am and 14.00 pm fed napier grass, while water serve *ad libitum*. The daily feed consumption were calculated by subtracting feed offered with residual feed in the next day, in dry matter basis. The does gave flusing diet three weeks before and two weeks after matting and following at two weeks before partus with ratio 30:25:45 of napier grass, basal concentrate and flushing diet, respectively. During pregnant, all does fed napier grass and basal concentrate in the ratio of 30:70 (based on dry matter). The basal concentrate consisted of soybean meal, corn gluten feed (CGF), dried cassava, $CaCO_3$, premix and salt. The rations were formulated isocaloric (TDN = 75%) and isonitrogenous (CP = 15%). The treatment of flushing diet containing source of fat as 5% of sunflower oil (R1), 5.2% of flaxseed oil (R2), 5% of *Lemuru* fish oil (R3) and 5.3% of tallow (R4) as presented in Table 1. Feed analysis was done for all feeds by proximate according to AOAC[7] method and showed at Table 2. Minerals as calcium and phosphorus were measured by Atomic Absorption Spectrophotometer (AAS) equipment[7], meanwhile value of TDN was calculated from the proximate data according to Wardeh[8].

Table 1: Composition of complete feed, consist of napier grass, basal concentrate and flushing diet fed 2 weeks before and after matting and 2 weeks before partus

	Groups (%)			
Ingredients	R1	R2	R3	R4
Napier grass	30	30	30	30
Basal concentrate	45	45	45	45
Flushing containing 5% sunflower oil	25	-	-	-
Flushing containing 5.2% flaxseed oil	-	25	-	-
Flushing containing 5.3% tallow	-	-	25	-
Flushing containing 5% *Lemuru* fish oil	-	-	-	25

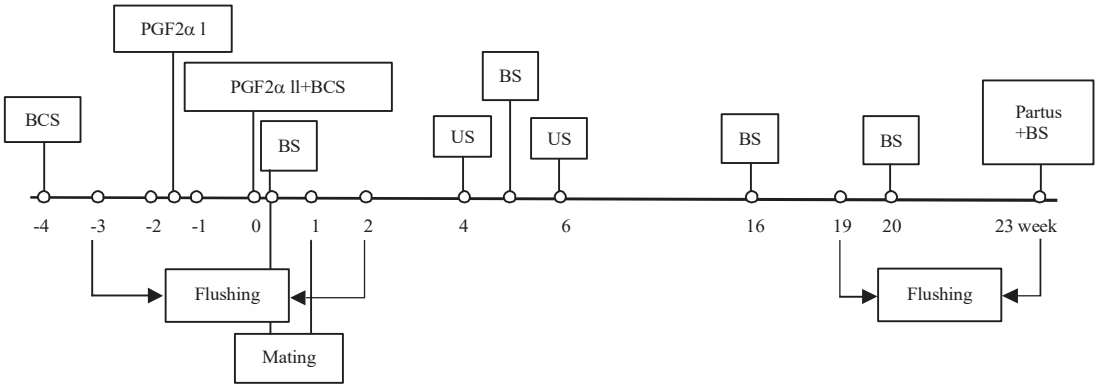

Fig. 1: Schedule of injection, blood sampling and USG monitoring
BCS: Evaluation of body condition score, BS: Blood sampling, PGF2α: Prostaglandin F2α injection, US: Ultrasonographic monitoring

Table 2: Nutrient composition flushing diets and basal concentrate for does (DM %)

	Basal concentrate (%)				Flushing diets
Nutrients	R1	R2	R3	R4	(%)
Crude protein	13.10	15.32	15.31	15.30	15.31
Extract ether	1.45	6.53	6.63	6.73	6.43
Crude fibre	15.08	13.03	13.02	13.02	13.02
TDN	71.14	75.11	75.28	75.34	75.21
Calcium	0.69	0.66	0.66	0.66	0.66
Phosphorous	0.29	0.32	0.32	0.32	0.32

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4: Diet containing 5% *Lemuru* fish oil, TDN: Total digestible nutrients

Estrus synchronization and follicel monitoring by ultrasonographic (USG): Synchronization was done by injection of prostaglandin (PGF2α) at a dose of 2 mg (b/v) per doe intramuscularly at left side of leg, after morning feeding time three weeks after flushing (Fig. 1). The repetition of injection was done within 11 days interval in order to make sure all does were estrus. The doe behaviour were observed to the characteristic of estrus during three days by observation of onset estrus, length of estrus and respond estrus. The estrus does were matted naturally with ratio to buck was 6:1 in colony pens during four days. The pregnancy test was done by observation of development of embryo at day 28th using ultrasound (USG) ALOKA model SSD-500 (ALOKA Co. Ltd., Japan) equipment with a 7.5 MHz linear probe.

Blood sampling for metabolites and hormone measurements: Blood samples were taken out start from second day after prostaglandin injection (estrus) then continued at early, mid, late gestation and just after partus[9]. The blood was collected through jugular vein using 5 mL disposable sterile syringe and filled in to a glass tube containing anticoagulant (EDTA). The blood samples was centrifuged at 3000 rpm for 15 min and then plasma was stored in microtubes in freezer at -20°C until continue to analyze glucose, cholesterol and hormones. The estradiol and progesterone hormones were measured by ELISA (enzyme linked immunosorbent assay) method. The color intensity was recorded by ELISA reader at the 450 nm wave length. The concentration of those hormones then were counted by Microplate manager (MPM) 6 program software. Meanwhile the glucose and cholesterol concentrations were analysed from plasma by using glucose and cholesterol Kits (Manufactured in Germany for PT. Rajawali Nusindo) with Catalog No. 112191 and Registration No. AKL 20101803460, respectively. Calculated glucose and cholesterol concentration were determined based on the formula given by the manufacturer using standard and sample absorbance as following:

$$\text{Glucose (mg dL}^{-1}) = \frac{\text{Absorbance sample}}{\text{Absorbance standard}} \times 100$$

$$\text{Cholesterol (mg dL}^{-1}) = \frac{\text{Absorbance sample}}{\text{Absorbance standard}} \times 200$$

Measurement of reproduction performance: Onset estrus was observed start from after injection until the estrus happened (h). Sign of estrus is shown by red, hot and inflamation surrounding the vulva. Duration of estrus was evaluated from start until finish of estrus, signed by rejection doe from the buck. The estrus respond was calculated from ratio number of total estrus doe divided by total population doe in each treatment times 100%. Percentage of pregnant was calculated from total number of pregnant doe divided to the total population in the treatment and times 100%. Litter size is the number of birth kid, meanwhile the pregnant period is the length duration of pregnancy, start from implant follicel on the uterus until partus.

Statistical analysis: All data obtained such BCS, nutrient consumptions in different period of pregnant, plasma glucose and cholesterol concentrations, estradiol and progesterone concentration and also reproduction performance were analyzed statistically with analysis of variance (ANOVA) by using SAS software version 9.4 based on randomized completely block design (RCBD). The Duncan's multiple range test was employed for comparison among different treatment mean when ANOVA result for a certain parameter significant at $p<0.05$. The statistical model of RCBD as follow by Steel and Torrie[10]:

$$Y_{ij} = \mu+P_i+\beta_j+\epsilon_{ij}$$

where, Y_{ij} is observed value, μ is overall mean, P_i is treatment effect, β_j is block (replicate) effect and ϵ_{ij} is random residual error.

RESULTS

Body condition score: Data of body weight change showed that there were no significance difference of initial and final body weight (BW) of does among the treatments before flushing. The body condition score (BCS) prior and after flushing program by using plant oil (sunflower in R1 and flaxseed in R2) and animal fat (tallow in R3 and *Lemuru* fish in R4) were similar ($p>0.05$) in all treatments (Table 3). The increasing of BCS value range from 0.83-0.88, where flushing diet containing flaxseed has tendence to be higher ($p<0.09$) compared to other treatments.

Nutrient consumption: Data of DM consumption are divide into three physiological status, during early flushing, during five months of pregnant and during late flushing. In general, the DM intake showed that with different flushing diets containing plant oil (sunflower and flaxseed) or animal fat (tallow and *Lemuru* fish) not differ significantly. The average feed intake increased gradually, start from 3.0% DM of body weight during early flushing (before and after mating, Table 4), continued during five months of pregnant to be 3.25% DM of body weight (Table 5) and late pregnant (before partus) by second flushing become 3.50% DM of body weight (Table 6). The nutrient intake including crude protein, crude lipid, crude fibre, calcium, phosphors and TDN were similar also in all treatments due to the same quality of diet (Table 4 for early flushing). Nutrient intake of Etawah crossbred does during pregnant fed by basal ration showed similar in all treatments due too fed by same basal diet (Table 5). This condition also followed by information of nutrient intakes during second flushing on late pregnant (Table 6).

Table 3: Body condition score (BCS) of does before and after flushing

Components	R1	R2	R3	R4
Initial BW	34.12±3.75	34.58±3.67	33.35±3.85	33.28±4.37
BW before matting	35.53±3.71	36.03±3.19	34.72±4.08	34.98±5.97
BCS before flushing	1.92±0.30	1.92±0.30	1.92±0.20	1.92±0.20
BCS after flushing	2.67±0.38	2.79±0.19	2.75±0.22	2.75±0.22
ΔBCS	0.75±0.16	0.88±0.14	0.83±0.13	0.83±0.13

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4: Diet containing 5% *Lemuru* fish oil, Δ BCS: Difference of BCS before and after flushing, BW: Body weight

Table 4: Nutrient consumption of Etawah crossbred doe during flushing program

Nutrients	R1 (g h^{-1}/day)	R2 (g h^{-1}/day)	R3 (g h^{-1}/day)	R4 (g h^{-1}/day)
Dry matter	964.22±140.51	964.50±118.42	1042.30±156.76	951.39±259.28
Crude protein	147.72±21.53	147.66±18.13	159.47±23.98	144.66±39.70
Ether extract	59.20±8.63	63.95±7.85	70.15±10.55	61.17±16.67
Crude fibre	125.64±18.31	125.58±15.42	135.71±20.41	123.87±33.76
TDN	724.22±105.54	726.07±89.14	785.27±118.10	715.54±195.00
Calcium	6.36±0.93	6.37±0.78	6.88±1.03	6.28±1.71
Phosphorus	3.09±0.45	3.09±0.38	3.34±0.50	3.04±0.83

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4: Diet containing 5% *Lemuru* fish oil, TDN: Total digestible nutrients

Table 5: Nutrient consumption of Etawah crossbred does during pregnancy fed basal diet

Nutrients	R1 (g h^{-1}/day)	R2 (g h^{-1}/day)	R3 (g h^{-1}/day)	R4 (g h^{-1}/day)
Dry matter	1131.43±90.20	1242.50±80.51	1191.22±229.24	1211.87±179.40
Crude protein	148.22±11.82	162.77±10.55	156.05±30.03	158.75±23.50
Ether extract	16.41±1.31	18.02±1.17	17.27±3.32	17.57±2.60
Crude fibre	170.62±13.60	187.37±12.14	179.64±34.57	182.75±27.05
TDN	811.45±64.69	891.12±57.74	854.34±164.41	869.15±128.67
Calcium	8.03±0.64	8.82±0.57	8.46±1.63	8.60±1.27
Phosphorus	3.73±0.29	4.10±0.27	3.93±0.75	4.00±0.59

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4: Diet containing 5% *Lemuru* fish oil, TDN: Total digestible nutrients

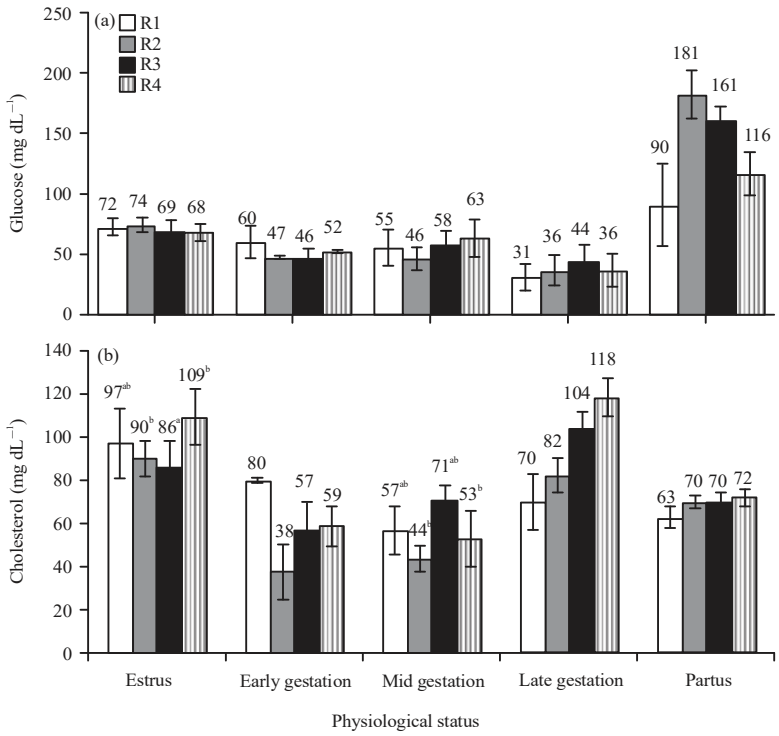

Fig. 2(a-b): (a) Plasma glucose and (b) Plasma cholesterol of Etawah crossbred does during estrus, early, mid and late gestation with flushing program

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4 diet containing 5% *Lemuru* fish oil, different superscripts in the different column means significantly different ($p<0.05$)

Table 6: Nutrient consumption of Etawah crossbred does during last periode of flushing before partus

Nutrients	R1 (g h^{-1}/day)	R2 (g h^{-1}/day)	R3 (g h^{-1}/day)	R4 (g h^{-1}/day)
Dry matter	1349.75±95.89	1429.93±153.63	1456.92±326.19	1405.95±294.38
Crude protein	206.78±14.69	218.92±23.52	222.91±49.91	215.25±45.07
Ether extract	82.87±5.89	94.80±10.19	98.05±21.95	90.40±18.93
Crude fibre	175.87±12.49	186.18±20.00	189.69±42.47	183.06±38.33
TDN	1013.80±72.02	1076.45±115.65	1097.64±245.75	1057.42±221.40
Calcium	8.91±0.63	9.44±1.01	9.62±2.15	9.28±1.94
Phosphorus	4.32±0.31	4.58±0.49	4.66±1.04	4.50±0.94

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4: Diet containing 5% *Lemuru* fish oil, TDN: Total digestible nutrients

Blood metabolites: Values of blood glucose start from early, mid, late gestation until partus showed in Fig. 2a. Data showed that the glucose concentration at partus were higher compared to at the early, mid and late gestation. Meanwhile, the cholesterol plasma during estrus (Fig. 2b) in flushing treatment with tallow (R3) was significance higher than flaxseed oil (R2) or *Lemuru* fish oil (R4) treatments ($p<0.05$), but similar with sunflower oil (R1) treatment. The cholesterol is important as steroid hormone precursor. Although cholesterol concentration during estrus was significant but did not give affect to estradiol concentration during estrus.

Hormones profiles: Estradiol concentration during estrus was not significance difference in all treatments, while during early gestation estradiol level in treatment sunflower oil (R1) was significantly higher ($p<0.05$) than *Lemuru* fish oil (R4) treatment, but were not different with flaxseed oil (R2) and tallow (Fig. 3a). Differences of fat sources have significant effect ($p<0.05$) to progesterone levels during estrus and late gestation (Fig. 3b). Flaxseed oil supplementation in the flushing diet had the highest levels of progesterone ($p<0.05$) during estrus. At the late gestation, flushing treatment using flaxseed oil and *Lemuru* fish oil had higher progesterone level ($p<0.05$) compared to the treatment with tallow, but similar with sunflower oil treatment.

Table 7: Performance reproduction of Etawah crossbred does fed different flushing diet

Parameters	R1	R2	R3	R4
Onset estrus (h)	45.33±38.33	32.67±31.10	65.67±48.64	88.75±41.81
Length of estrus (h)	39.83±17.83	35.33±10.17	35.17±17.76	39.50±13.10
Respond estrus (%)	100	100	100	100
Pregnancy (%)	100	100	100	100
Total embryo	1.50±0.55^{b}	2.17±0.41^{a}	1.83±0.41^{ab}	2.00±0.63^{ab}
Litter size	1.20±0.40	1.67±0.52	1.50±0.58	1.80±0.45
Ratio single:twin	4:1	2:4	3:2	2:4
Ratio male:female	2:4	8:2	3:4	4:6
Pregnant periode (d)	148.00±4.06	152.50±4.46	150.25±2.87	148.40±2.61
Birth weight	4.04±1.09	5.30±1.29	5.45±2.27	5.49±1.03

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4: Diet containing 5% *Lemuru* fish oil, different superscripts in the same line means significantly different (p<0.05)

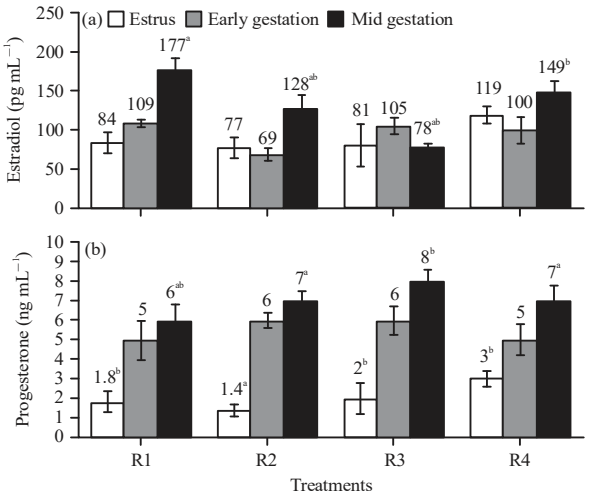

Fig. 3(a-b): (a) Plasma estradiol and (b) Plasma progesterone of etawah crossbred does during estrus, early and late gestation with flushing program

R1: Diet containing 5% sunflower oil, R2: Diet containing 5.2% flaxseed oil, R3: Diet containing 5.3% tallow, R4: Diet containing 5% *Lemuru* fish oil, different superscripts in the same column means significantly different (p<0.05)

Reproduction performance: Data statistically showed that flushing diet with difference oil sources did not affect to the reproduction performance, except to the total embryo. The treatments containing flaxseed oil significantly increased the total embryo (p<0.05), as showed at Table 7.

DISCUSSION

Flushing program is addressed to improve body performance before mating, especially for primiparous animal. Feeding management in small ruminant showed that flushing treatment could improve ovulation, BCS, increasing of fertility, prevent of silent estrus, increase of twin and fetus implant on uterus[11]. The nutrient content of flushing diet in this experiment has high quality of PUFA (sunflower, flaxseed and *Lemuru* fish oil) which could be as a steroid hormone precursor. Beside the hormone status, the BCS status of animal also could be used for improving reproduction program. The normal BCS score for doe which ready to mate is around 2-3, which is same with the etawah crossbred does BCS status in this experiment[12]. Dry matter consumption during flushing in this research (950-1040 g h^{-1}/day) was higher compared to NRC recommendation (650 g h^{-1}/day) for pregnant does[13]. This research showed that the DM intake was around 3.25% dry matter of BW and increased in total following the physiological status of pregnancy (Table 4-6). The quality of basal diet which given during pregnant with low crude protein and TDN was aimed to increase feed intake become 3.50%. Quality of feed is more important for late pregnant animal. This statement is supported by Orskov[14] where the DM intake is depend on the physiological status, body weight and quality of feed. Nutrient requirements for pregnant goat is depend on the status pregnancy and body weight[15]. It is reported by Khotijah *et al.*[16] that supplementation of 4% sunflower oil on pregnant ewes have not decreased of DM intake, meanwhile the protein intake was around 145-151 g h^{-1}/day, which is similar with result in this experiment. In this experiment, data of protein intake showed twice higher compared to NRC recommendation[13] which should be around 70-87.50 g h^{-1}/day with 30 kg of BW. The condition of low nutrient status does before pregnant with BCS around 1.90 caused a compensation of protein intake during pregnant. The energy consumption of feed will influence the regulation of systemic hormonal concentrations and follicular fluid[17]. It has been reported that short-term nutritional supplementation 6-10 days prior to mating would induce reproductive responses in female goats that would be similar to those documented for female sheep[18].

It was reported that glucose concentration in pregnant Etawah crossbred goat around 114 mg dL^{-1} without flushing treatment[2,19]. This research showed that the glucose concentration during estrus until mid pregnant was around 50-70 mg dL^{-1} and the concentration getting down before partus and increased significantly almost three times after partus (Fig. 2a). Glucose and other metabolites are precursor for milk synthesis in mammary gland during lactation[19]. The cholesterol concentrations during estrus and late gestation were high to support steroids hormone (Fig. 2b). Cholesterol is precursor steroid hormone and together with milk fat syntesis[20].

Research conducted by using sunflower oil with high PUFA in the ration could improve significantly estradiol concentration in order to support reproduction performance of ewes[6]. Treatment with sunflower in this research also have high estradiol. The low estradiol levels during early gestation are very important to improve embryonic survival because they will prevent early corpus luteum regression, as reported by Petit and Twagiramungu[21]. The concentration of progesterone during estrus and late pregnant were the highest in flaxseed and *Lemuru* fish oil, meanwhile in the sunflower oil was the lowest. This result is appropriate with the number of embryos in this study, which treatment with sunflower oil has the lowest number of embryos (Table 7). The hormone profiles in this study is similar with other researcher that a higher of progesterone levels in cow indicated from flaxseed supplementation[22]. High levels of progesterone in the treatment of flaxseed oil and *Lemuru* fish oil are due to both of those oils being a source of oil rich in omega-3s. Omega-3 has a function in pressing PGF2α synthesis and preventing corpus luteum regression. Linoleic acid (omega-6) from sunflower oil in the body is converted to dihomo-γ-linolenate (DGLA) and arachidonic acid, DGLA can also press PGF2α, but DGLA will also be converted to arachidonic acid[21]. Flaxseed oil contain omega-3 with high linolenic acid that could convert to EPA and DHA and then to be prostaglandin E3. The prostaglandin convert to progesterone which can prevent the corpus luteal to maintain the pregnancy condition. Further more, it is reported that the linolenic acid can also maintain the male embryo[16]. Supplementation omega-3 in the diet could make longer time of estrus so that improve the prolific index[23]. The onset estrus in flaxseed oil treatment of this study was tendons to be shorter than other treatments, but longer time than previous researcher[1], 23.49 h. The normal onset estrus in local tropical does is around 31-45 h[2]. The variation of onset estrus after synchronization is affected by ovarium activity, corpus luteum active and reproduction cycle. It is recommended that the using flaxseed oil for flushing diet will increase number of embryo.

CONCLUSION

It is concluded that flushing diet containing 5.2% flaxseed oil (with PUFA) for does, given three weeks before matting, two weeks after mating and continued with two weeks before partus could increase prostaglandin level and the number of total embryo. The alternative utilization of PUFA *Lemuru* fish oil in the flushing diet could increase the number of embryonic in etawah crossbred does.

SIGNIFICANCE STATEMENT

This study discovers the formula of flushing diet containing poly unsaturated fatty acid from flaxseed oil for improving reproduction performance of does. This study will help the researcher and farmer to increase the kidding rate and provision of animal protein that many researchers were not able to explore. Thus, a new formula of flushing diet based on PUFA of flaxseed oil and possibly other combinations, may be arrived at.

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