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Bogor Agricultural University



Sustainable Livestock Production in the Perspective of Food Security, Policy, Genetic Resources, and Climate Change

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Ministry of Agriculture



Indonesian Society of Animal Sciences



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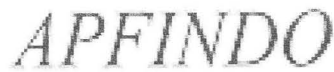
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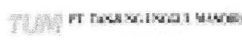
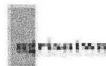
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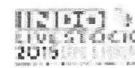
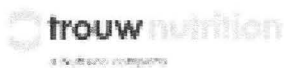
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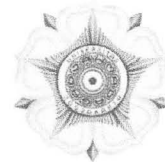
SUSTAINABLE LIVESTOCK PRODUCTION IN THE PRESPECTIVE OF FOOD SECURITY, POLICY, GENETIC RESOURCES, AND CLIMATE CHANGE

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Reproductive Performances of Garut Sheep Fed Rations Containing Sunflower Oil as a Source of Linoleic Acid.

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ABSTRACT

The study was aimed to evaluate the effects of supplementation of linoleic acid derived from sunflower oil on reproductive performances of Garut sheep. Animals used were primiparous Garut ewes (initial body weight of 22.12 ± 1.69 kg), and 4 rams with the same fertility. The experiment used completely randomized design (CRD) with 4 treatments and 8 replications. Treatments consisted of four rations with different levels of sunflower oil. Levels of sunflower oil were added based on the maintenance level of linoleic acid. M0=without sunflower oil, M1=2% sunflower oil, M2=4% sunflower oil and M3=6% sunflower oil. Parameters measured were the percentage of pregnancy, the length of pregnancy, the number of embryos, litter size, the percentage lost of embryo, single-twin birth ratio and sex ratio of lambs. Data were analyzed by ANOVA and Chi Square (χ^2), except the lost of embryo was described descriptively. The results showed that the treatments did not significantly affect the number of embryos and litter size. The lost of embryo was M0 (-28.5%), M1 (38.46%), M2 (0%) and M3 (-7.69%). The percentage of pregnancy of sheep fed ration containing 4% sunflower oil was higher than the other treatments. The single-twin birth ratio and sex ratio of lambs were significantly affected ($p < 0.001$) by the addition of sunflower oil. It can be concluded that the increased levels of linoleic acid up to 3 times of the maintenance requirement of sheep (6% sunflower oil in ration) improve reproductive performances of sheep. The best reproductive performance is achieved on the ration containing linoleic acid 2 times of maintenance requirement or 4 percent sunflower oil.

Key Words : Garut ewes, Linoleic, Reproductive, Sunflower oil

INTRODUCTION

Sufficiency and quality of nutrients are important factors for good animal reproduction. Energy is one of the nutrients which is very important to support the process of reproduction of livestock. O'Callaghan et al. (2000) stated that the energy consumption of feed will influence the regulation of systemic hormonal concentrations and follicular fluid. The quality of energy ration can be improved by the addition of a source of essential fatty acids.

Some researchers reported that the fatty acid composition of the ration, may improve animal reproduction (Watches et al., 2007), can increase the number and size of follicles ovulated, increase survival and improve the fertility of the corpus luteum of cows (Staples et al. 1998). Zachut et al. (2008) stated that in dairy cows, the levels of unsaturated fatty acids increased the size of steroid hormones in the follicular phase preovulatori were beneficial for ovarian function. Linoleic acid (omega-6) is one of concern to improve reproduction on livestock, especially at pregnancy. Linoleic acid (18:02, n-6) is metabolized to arachidonic acid (n-6 20:04), as a precursor of type 2 prostaglandin (PGE2). Increased consumption of n-6 18:02 during pregnancy can alter the synthesis of prostaglandins during parturition (Elmes et al. 2004).

Sunflower oil is one source of vegetable oils which has high linoleic acid content. The study was aimed to evaluate the effect of supplementation of linoleic acid derived from sunflower oil on reproductive performances of garut sheep.

MATERIALS AND METHODS

Experimental animals, feeding and design

Thirty two Garut ewes primiparous (BW 22,12±1,69 kg, aged 12-14 months) were assigned into a completely randomized design with 4 treatment rations containing different levels of sunflower oil namely: M0=without sunflower oil, M1=2% sunflower oil, M2=4% sunflower oil and M3=6% sunflower oil. Rations consisted of *Brachiaria humidicola* grass and concentrate in the ratio of 30:70. The concentrate consisted of cassava meal, coconut meal, soybean meal, sunflower oil and minerals. Chemical compositions of the experimental diets are shown in Table 1.

Table 1. Chemical composition of the concentrate containing different level of sunflower oil and grass (dry matter basis)

Nutrients	Concentrate				<i>Brachiaria humidicola</i>
	M0	M1	M2	M3	
	-----%				
Dry Matter	86.99	85.63	87.00	87.16	20.81
Crude Protein	21.40	20.81	19.95	20.41	12.88
Ether Extract	3.79	4.65	7.49	8.05	0.76
Crude Fiber	7.59	8.42	8.13	8.64	33.20
NFE	60.80	59.69	58.02	57.26	45.86
Linoleic	0.096	0.65	1.62	2.12	0.17
Ca	0.97	1.17	1.07	0.98	0.63
P	1.07	0.94	0.89	0.88	0.35

Oestrous synchronization, reproductive performances and statistical analysis

Oestrous synchronization was conducted by injecting PGF_{2α} (Noroprost[®], Norbrook Laboratories Limited) hormone intramuscularly twice. Estrous synchronization was conducted by double injection of Prostaglandin (PGF_{2α}) with 11 days apart before mating. Pregnancy rate was determined as the percentage of ewes pregnant per ewes mated (Ultrasound scanning). Prolificacy or litter size was calculated as the number of lambs born per number of ewes lambing. Sex ratio of lambs was calculated as ratio of male lambs per number of female lambs. Data were analyzed using IBM SPSS Statistics version 20.0. (2011). Some reproductive performances were analyzed using Chi Square (χ^2) Test. The lost of embryo was described descriptively.

RESULTS AND DISCUSSION

Reproductive performances including the percentage of pregnancy, number of embryos, length of gestation, litter size, percentage lost of embryo, type of birth, and sex ratios are presented in Table 2.

Percentage of pregnancy

Percentage of pregnancy of ewes consumed ration with 4% sunflower oil was 12.5% higher than the control and 25% higher than those ewes fed rations containing 2% and 6% sunflower oil treatments. This suggests that the addition of 4% sunflower oil in the ration can prepare the uterus to the fertilization process better. Sunflower oil as a source of unsaturated fatty acid can provide precursor of steroid hormones that are essential for reproduction. Zachut et al. (2008) stated that in dairy cows, the levels of unsaturated fatty acids in the rations increased follicle size and raised preovulatori steroid hormones in follicular phase, which is beneficial to ovarian function. Fouladi-Nasha et al. (2007), also stated that the feed fatty acids can provide benefits to the development and maturation of oocytes as well as preimplantation of embryos during in vivo in dairy cows, however the specific roles and mechanisms need to be studied further.

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Table 2. Effect of sunflower oil levels on reproductive performances

Parameters	Treatments			
	M0	M1	M2	M3
Percentage of pregnancy (%)	87.5	75	100	75
Number of embryos	1.86±0.38	1.75± 0.50	2.25± 0.46	2.17± 0.41
Length of pregnancy (days)	137.2±14.91	149.75±13.96	146.38±2.33	146.33±20.09
Litter size (head/ewe)	1.33±0.52	2.40±0.89	2.25± 1.17	2.00±0.631
Percentage lost of embryo (% *	-28.5	+38.46	0.00	- 7.69
Single-twin birth ratio	37:67	80:20	62:38	83:17
Sex ratio of lambs. (male:female)	58:42	37:63	75:25	56:44

$$* = \frac{(\text{the number of embryos} - \text{the number of lambs})}{\text{the number of embryos}} \times 100\%; (+) = \text{added}; (-) = \text{loses}$$

Length of pregnancy

No statistically significant difference for the length of pregnancy of the four treatments. In this research the length of pregnancy of control ewes (M0) was below the range of some other researchers. This is thought to be related to the lack of availability of linoleic. Cheng et al. (2005) and Chahs et al. (2002) stated that the high linoleic diet could increase production of prostaglandins parent and placental tissue, so it can influence the development of the fetus and placenta and can play a role in determining the time and childbirth. However, in this study the levels of sunflower oil up to 6% did not disrupt birth rate.

Litter Size and Type of Birth

Litter size was very significantly affected by the addition of sunflower oil in the ration ($p < 0.001$). It was explained that the improved of feed quality by the addition of sunflower oil as sourced of linoleic acid can raise prolific genetic potential of garut sheep. Sunflower oil increased intake of energy to ovum maturation and ovulation. Some researchers reported that the addition of energy in the ration of sheep and goats before mating can stimulate ovulation and improve the implantation of the fetus in the uterus (El-Nour et al. 2012), increased the number of multiple births (Camelo et al., 2008).

Percentage lost of embryo

There are differences in the number of embryos detected by the number of the lamb born at 28.5% for control (M0). The ewes fed high levels of linoleic (2 times maintenance or 4% sunflower oil (M2) and 3 times of maintenance or 6% sunflower oil (M3) in rations) resulted [in] the same number of lambs relative to the number of embryos detected. Linoleic acid or other essential fatty acids from sunflower oil was able to produce the progesterone hormone that plays a role on preserving and maintaining the pregnancy, thus the embryos developed could be maintained until birth. Pour (2011) stated that steroid hormones can play an important role in maintaining of pregnancy, the formation of sex hormones and protein, energy and minerals metabolized, retain of placenta, inhibit uterine contractility during pregnancy and prepare the mammary.

Sex ratio of lambs

Lambs sex ratio was highly significant ($p < 0.001$) influenced by the addition of sunflower oil as a source of linoleic. Ewes consumed rations containing 4% sunflower oil produced male offspring more than female (75%: 25%) and very significantly higher than the other treatments. Gulliver (2011) stated that the types and levels of length chain unsaturated fatty acids in the feed can affect the sex ratio of offspring. Green et al. (2008) reported that increasing polyunsaturated fatty acids omega-6 (linoleic) in sheep rations produced higher number of male lamb than females. In this study, an increased intake of linoleic as poly unsaturated fatty acid will

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contribute to the energy status to improve the condition of the ewes. Cameron (2004) stated that there are three main factors of parent nutritional that can affect the sex ratio of children, i.e food, conditions and body weight of the mother. Cameron (2004) stated that even though many researchers tried to prove how the mother nutrition can influence the sex of offspring, however they are still not able to explain how the mechanism is. Grant and Chamley (2010) stated that further research should be focused on molecular mechanisms to know how the nutrient conditions of parent influence the sex of the child clearly. If this is known, it can be carried out manipulation or modification of sex selection for sheep development strategy.

It can be concluded that the increased levels of linoleic acid up to 3 times of the maintenance requirement of sheep (6% sunflower oil in ration) improve reproductive performances of garut sheep. The best reproductive performance is achieved on the ration containing linoleic acid 2 times of maintenance requirement or 4 percent sunflower oil.

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