Improvement of Lamb Preweaning Performance by Combination of Superovulation of Ewes Prior to Mating and *Temulawak* Extract Plus Administration During Pregnancy

Andriyanto*, MD Darulfallah, R Arif, GM Nugraha, A Winarto and W Manalu

Department of Anatomy, Physiology, and Pharmacology, Faculty of Veterinary Medicine, Bogor Agricultural University
Jl. Agatis, Kampus IPB Darmaga Telp:0251-8629462, Fax: 0251-8629462, Indonesia
***Corresponding author email: ayanvet@yahoo.com**

Abstract. Superovulation is one of a reproductive technology to improve livestock productivity. The research was conducted to optimize the superovulation technology by combining it with administration of *temulawak* extract plus during pregnancy. Sixteen ewes were injected prostaglandin hormone at a dose of 10 mg/kg body weight intramuscularly twice, with eleven days interval, to synchronize estrous cycle. On the eleventh day, superovulation was induced by injection of pregnant mare serum gonadotrophin hormone at a dose of 200 IU/ewe intramuscularly. The ewes showing the estrous signs were mated naturally. *Temulawak* extract plus was administered weekly during pregnancy with a dose of 1 mg/kg body weight. Parameters measured in this study were lambs birth weight and preweaning growth. Superovulation increased average litter size. The result showed that, regardless of litter size, superovulation increased lambs birth weight by 15% as compared to controls and *temulawak* extract plus groups. Superovulation before mating and *temulawak* extract plus administration during pregnancy improved lambs growth in the first month and the third month postpartum. Superovulation prior to mating increased lambs birth weight and improved lambs growth performance before weaning.

Keywords: superovulation, *temulawak* extract plus, lambs growth performance, ewes

Abstrak. Superovulasi merupakan salah satu teknologi reproduksi untuk meningkatkan produktivitas ternak. Penelitian ini dilakukan untuk mengoptimalkan teknologi superovulasi dengan menggabungkan pemberian ekstrak temulawak plus selama kebuntingan. Enam belas domba disuntik hormon prostaglandin dengan dosis 10 mg/kg bobot badan secara intramuskular sebanyak dua kali, dengan selang waktu sebelas hari, untuk menyesuaikan siklus estrus. Pada hari ke sebelas, superovulasi diinduksi dengan injeksi pregnant mare serum gonadotrophin hormon dengan dosis 200 IU/domba secara intramuskuler. Domba yang menunjukkan tanda-tanda estrus kemudian dikawinkan secara alami. Ekstrak temulawak plus diberikan setiap minggu selama kebuntingan dengan dosis 1 mg/kg bobot badan. Parameter yang diukur dalam penelitian ini adalah bobot lahir anak domba dan pertumbuhan prasapih. Superovulasi meningkatkan rata-rata litter size. Hasil penelitian menunjukkan bahwa, terlepas dari litter size, superovulasi meningkatkan bobot lahir anak domba sebesar 15% dibandingkan dengan kelompok ekstrak temulawak plus. Superovulasi sebelum kawin dan pemberian ekstrak temulawak plus selama kebuntingan meningkatkan pertumbuhan anak domba di bulan pertama dan bulan ketiga paska melahirkan. Superovulasi sebelum perkawinan meningkatan berat lahir anak domba dan meningkatan performa pertumbuhan anak domba sebelum penyapihan.

Kata kunci: superovulasi, temulawak ekstrak plus, kinerja pertumbuhan anak domba, domba

Introduction

Increased ovulating follicles and corporal luteal number by superovulation was proven to enhance endogenous pregnant hormones (estrogen and progesterone) secretion and improved reproduction and production performance in sheep, goats, cattle, and swine (Sudjatmogo et al., 2001; Adriani et al., 2004; Adriani et al., 2007; Mege et al., 2007; Andriyanto and Manalu 2011; Coello et al., 2008; Dupras et al., 2010). Increased endogenous secretion of pregnant hormones during pregnancy in superovulated mothers was reported to increase littersize, offspring birth weight, milk production, offspring preweaning growth performances (Manalu et

al., 2000; Sudjatmogo et al., 2001; Adriani et al., 2007; Mege et al., 2007; Andriyanto and Manalu, 2010).

The increased endogenous secretion of pregnant hormones improved fetal growth and mammary gland growth and development during pregnancy (Manalu et al., 2000; De Feu et al., 2008; Adriani et al., 2007; Mege et al., 2007; Dementrio et al., 2009; Cortes et al., 2008). The improved fetal and mammary gland growth and development during pregnancy would improve birth weight and milk production during lactation that finally improved preweaning growth and performance of the offspring. However, the increased litter size in superovulated mother also increased offspring mortality, especially in litter size of 3 or greater (Andriyanto and Manalu, 2010). To improve productive and reproductive performances of the superovulated mothers, it was proposed to use herbal formulation and feed supplement to improve maternal metabolic condition to support fetal growth and development during pregnancy.

Empirically, *temulawak* (*Curcuma xanthoriza*) has been used as a tonicum to improve body condition (Lee et al., 2008). The main ingredients of *temulawak* are xanthorizol and curcuminoid. Xanthorizol was reported to increase appetite and bile production (Choi et al., 2004; Nugroho, 2008) that was assumed to improve feed intake and feed digestibility. Curcuminoid was reported to inhibit bacterial growth (Wiryawan et al., 2005). Administration of *temulawak* containing these two main components would improve maternal condition during pregnancy. In addition to xanthorizol and curcuminoid content, *temulawak* extract plus formulation contains vitamins A, B complex, D, and calcium. This formulation could improve maternal nutrition metabolic, and health conditions during pregnancy (Kidd dan Paris, 2010; Rotondi and Khobzi, 2010; Witschi, 2011; Yoo et al., 2011) that would eventually improve fetal growth and offspring postnatal performance. This experiment was designed to improve preweaning offspring performances by combination of superovulation of the mother prior to mating with *temulawak* extract plus intake during pregnancy.

Materials and Methods

This experiment was conducted for 10 months in May 2010 to March 2011 on Mitra Maju Farm (Jl. Manunggal Baru 1, Tegal Waru, Ciampea, Bogor). Sixteen ewes aged around 15 months with body weight ranged from22 to 25 kg were used in this study. The experimental ewes were assigned into a completely randomized design with 2 x 2 factorial arrangement. The first factor was the dose of PMSG consisted of two levels, namely 0 (control) and 200 IU/ewe (superovulation). The second factor was the dose of *temulawak* extract plus consisted of two levels, namely 0 and 1 mg/kg bw.

Before mating, to synchronize estrous cycle, the experimental ewes were injected twice with prostaglandin (PGF2α) hormone (Lutalyse ® Pharmacia, Germany) with a dose of 10 mg/ewe, with eleven days interval. On the eleventh day after the first prostaglandin injection, the superovulated ewes were injected with PMSG hormone (PG600 ® Intervet, Holland) with a dose of 200 IU/ewe to stimulate superovulation. Around 24 to 36 hours after the second injection of prostaglandin, the experimental ewes were mixed with rams (with ratio of 1:8) for natural mating. After mating, the ewes were orally given *temulawak* extract plus every week during pregnancy with a dose of 1 mg/kg bw (based on calibration from human to sheep). The *temulawak* extract plus formulation consisted of *temulawak* extract and multivitamin (A, B complex, and D), and calcium.

At parturition, litter size was recorded and lambs birth weights were measured using digital scales (Genius®). Lambs body weights

were measured monthly until weaning period (4 months postpartum). Preweaning mortality of the experimental lambs were monitored and recorded during 4 months postpartum. Total lambs born per ewe, the number of lambs weaned, weaning weights, total weights of lambs weaned per ewe, and the lamb mortality until weaning were calculated. The data collected were analyzed by General Linear Model Univariate.

Results and Discussion

Litter size, average birth weight, total birth weight per ewe, weaning weight, and total weaning weight per ewe in the control and superovulated ewes administered *temulawak* extract plus are presented in Table 1. Superovulation of ewes prior to mating increased litter size by 66.67% compared to control. The increased litter size in superovulated ewes did not decrease birth weight. Lambs born to superovulated ewes with higher litter size however had higher birth weight by 15.14% compared to control.

The increased litter size in superovulated ewes was caused by the increased number of ovulating follicles and fertilized ova and embryos and fetal growth during pregnancy (Manalu et al., 2000; Nowshari and Ali, 2005; Mege et al., 2007). The improved birth weight is a result of the increased secretion of endogenous pregnancy hormones, estrogen and progesterone, during pregnancy (Adriani et al., 2004; Adriani et al., 2007; Rahman et al., 2008). Improved hormonal secretion during pregnancy in superovulated ewes would improve microuterus environment that supports embryo and fetal development (Mege et al., 2007; Topoleanu et al., 2008). The improved fetal growth and development in the superovulated ewes would result in a higher birth weight (Adriani et al., 2007; Mege et al., 2007).

By multiplying the litter size with birth weight, superovulated ewes produced a higher total birth weight that was almost twice as compared to that of control. The Increased total birth weight with the same degree was

Tabel 1. The number of lambs, average birth weight, total birth weight per ewe, litter size, preweaning mortality, the number of lambs weaned, average of weaning weight, total weaning weight, and lambs weaned per ewe ratio in control, superovulated ewes with or without *temulawak* extract plus administration

	Control		Tp		SO	Tp	SO* Tp
	Control n=4	SO n=4	Control n=4	SO n=4			
Number of lambs (head)	6	10	7	11			
Average birth weight (kg)	3.17±0.12	3.65±0.14	3.19±0.16	3.57±0.19	*	-	-
Total birth weight per ewe (kg)	19.02±0.12	36.5±0.14	22.33±0.16	39.27±0.19	*	-	-
Litter size (head)	1.5 (6/4)	2.5 (10/4)	1.75 (7/4)	2.75 (11/4)			
Preweaning mortality (%)	17	10	29	9			
Number of lambs weaned (head)	5	9	5	10			
Average of weaning weight (kg)	15.41±0.65	17.34±0.50	16.38±0.71	18.78±0.52	*	*	-
Total weaning weight (kg)	77.05	156.06	81.9	187.8	*	*	-
Lambs weaned per ewe ratio (head)	1.25 (5/4)	2.25 (9/4)	1.25 (5/4)	2.5 (10/4)			

SO: superovulation, Tp: *Temulawak* extract plus, *: there was interaction between superovulation and *temulawak* extract plus, -: there was no interaction between superovulation and *temulawak* extract plus

also reported in superovulated goat (Adriani et al., 2007; Andriyanto and Manalu, 2011).

The improved lamb birth weight in superovulated ewes would increase lamb preweaning performance and health condition that eventually reduced mortality by 41.17% compared to control. The improved preweaning performance was related to the reported increase in milk production in superovulated sheep and goats (Manalu et al., 2000; Adriani et al., 2004) in addition to the improved lamb birth weight (Sumaryadi and Manalu, 2001; Andriyanto and Manalu, 2010).

Temulawak extract plus administration during pregnancy improved birth weight by 6.31%. Combination of *temulawak* extract plus administration with superovulation improved birth weight by 12.62%.The improved lamb birth weight in ewes administered with *temulawak* extract plus during pregnancy was followed by the improved lamb preweaning performance with a lower mortality and a higher weaning weight by 6.29% (Table 1). The increased preweaning performance in lambs born to ewes administered with *temulawak* extract plus during pregnancy was assumed to be affected by xanthorizol and curcuminoid content of *temulawak* that were reported to improve appetite, have antibacterial activity and tonicum effect (Choi et al., 2004; Wiryawan et al., 2005; Lee et al., 2008; Nugroho, 2008). Multivitamin and calcium contained in the *temulawak* extract plus could improved nutrient requirement of sheep and fetus that finally improved prenatal growth and birth weight (Kidd and Parris, 2010; Witschi, 2011). According to Lee et al. (2008), *temulawak* contains camphor that induces a comfortable condition and increase feed intake. Chemical substances in *temulawak* can also stimulate gastrointestinal motility that improves appetide and feed digestibility (Choi et al., 2004; Haryono, 2006). Lamb growth rates during preweaning period in this experiment are presented in Figure 1.

Combination of superovulation of ewes prior to mating and *temulawak* extract plus administration during pregnancy could increase lamb growth rate 1 to 3 months postpartum by 27% as compared to control. Superovulation

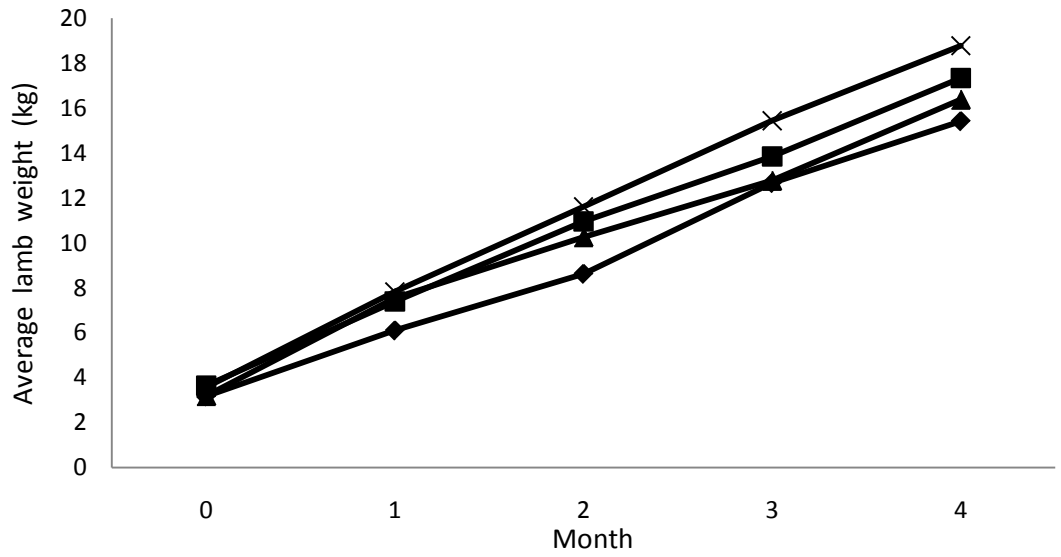

Figure 1.The average lamb birth weight, preweaning growth (1 up to 4 month), and weaning weight in control group (♦), administered *temulawak* extract plus group (▲), superovulationgroup(■), andcombination superovulationand administered *temulawak* extract plus group (x).

alone without *temulawak* extract plus administration could improve lamb growth rate 1 to 3 months postpartum by 18% compared to control. *Temulawak* extract plus administration alone without superovulation could improve lamb growth rate 1 to 3 months postpartum by 12% as compared to control. The improved birth weight and lamb growth rate until three months post partum did not increase linearly until weaning. Superovulation alone increased weaning weight by 12.5% compared to control and *temulawak* extract plus administration alone increased weaning weight by 6% compared to control.

Conclusions

Superovulation of ewes prior to mating clearly improved sheep reproduction and production performances as indicated by the total weaning weight. *Temulawak* extract plus administration could improve sheep reproduction and production performances but lower than superovulation. Superovulation and *temulawak* extract plus administration sinergically improved sheep reproduction and production performances.

Acknowledgement

The author would like to thank to Mitra Maju Farm at Jl. Manunggal Baru No. 1, Tegal Waru, Ciampea, Bogor that accommodated and support this experiment.

References

Adriani, A Sudono, T Sutardi, W Manalu and IK Sutama. 2004. Pengaruh superovulasi dan suplementasi mineral seng dalam ransum pada induk kambing terhadap pertumbuhan anaknya. J. Indon. Trop. Anim. Agric. 29(4):180-181

Adriani, A Sudono, T Sutardi, W Manalu and IK Sutama. 2007. Pertumbuhan prenatal dalam kandungan kambing melalui superovulasi. Anim. Prod. 14:44-48

Andriyanto and W Manalu. 2010. Prospek penerapan teknologi perbaikan sekresi endogen hormon kebuntingan pada domba skala peternakan rakyat. *Prosiding.* Seminar Nasional Peranan Teknologi Reproduksi Hewan Dalam Rangka Swasembada Pangan Nasional. Bagian Reproduksi dan Kebidanan Departemen Klinik Reproduksi dan Patologi Fakultas Kedokteran Hewan Institut Pertanian Bogor. Bogor. Hlm. 125-127.

Andriyanto and W Manalu. 2011. Increasing goat productivity through the improvement of endogenous secretion of pregnant hormones using follicle stimulating hormone. Anim. Prod. 13(2):89-93.

Choi MA, SH Kim, WY Chung, JK Hwang and KK Park. 2004. Xanthorizol, a natural from *Curcuma xanthoriza*, has an antimetastatic potential in experimental lung metastatic model. Biochemical and Biophysical Communication. 326:210-217.

Coello MJ, R González, C Crespo, M Gomendio and ERS Roldan. 2008. Superovulation and in vitro oocyte maturation in three species of mice (Mus musculus, Mus spretus and Mus spicilegus. Theriogenology. 70:1004-1013.

Cortes MAC, CS Torres, JCV Chagoyán, HMS Gómez, GG Fariña and MAM Ríos. 2006. Rat embryo quality and production efficiency are dependent on gonadotrophin dose in superovulatory treatments. Laboratory Animals. 40:87-95.

Demetrio DGB, A Magalhaes, K King and CGB Demetrio. 2009. Differences in embryo production between lactating and non-lactating holstein donor cows. Reproduction, Fertility & Development. 21:168-175.

De Feu MA, J Patton, ACO Evans, P Lonergan and ST Butler. 2008. The effect of strain of Holstein–Friesian cow on size of ovarian structures, periovulatory circulating steroid concentrations, and embryo quality following superovulation. Theriogenology. 70:1101-1110.

Dupras R, J Dupras and Y Chorfi. 2010. Estradiol-17β concentrations in blood and milk during superovulatory treatment in dairy cows. Reproduction, Fertility, & Development.22:245-245.

Haryono B. 2006. Perbaikan pertumbuhan dan produksi karkas kelinci melalui pemberian ekstrak *temulawak* (*Curcuma xanthorrhiza Roxb*) pada ransum. Anim. Prod.8:190-195.

Kidd and Parris. 2010. Vitamin D and K as pleiotropic nutrient: clinical importance to the skeletal and cardiovascular system and preliminary evidence for synergy. Alternative Medicine Review. 15:199-222.

Lee YL, SJ Seok, R Yaya and HJ Kwan. 2008. Antibacterial activity of xanthorizol isolated from Curcuma xanthoriza Roxb. against foodborne pathogens. J. Food Protection. 71:1926-1930.

Manalu W, MY Sumaryadi, Sudjatmogo and AS Satyaningtijas. 2000. The effect of superovulation prior to mating on milk production performance during lactation in ewes. J. Dairy Sci. 83:477-484.

Mege AR, SH Nasution, N Kusumorini and W Manalu. 2007. Growth and development of the uterus and placenta of superovulated gilts. Hayati J. Biosci. 14:1-6.

Nowshari MA and SA Ali. 2005. Effect of season and gonadotropins on the superovulatory response in camel (*Camelus dromedaries*). Theriogenology. 64:1526-1535.

Nugroho B, DP Malau, F Rokhmanto and N Laili. 2008. Pengaruh suhu ekstraksi terhadap kandungan kurkuminoid dan air serbuk *temulawak* (*Curcuma xanthorrhiza*). LIPI:1-10.

Rahman ANMA, RB Abdullahand WE Wan-Khadijah. 2008. Estrus synchronization and superovulation in Goats: Review. J. Biological Sci. 8:129-1137.

Rotondi MA and N Khobzi. 2010. Vitamin A supplementation and neonatal mortality in the developing world: a meta-regression of cluster-randomized trials. Bull World Health Organ. 88(9):697-702.

Sudjatmogo, B Utomo, Subhiarta, W Manalu and Ramelan. 2001. Tampilan produksi susu akibat peningkatan pertumbuhan ambing sapi perah Friesian Holstein yang disuntik pregnant mare serum gonadotrophin pada program perkawinannya. J. Pengembangan Peternakan Tropis. 26:8-13.

Sumaryadi MY and W Manalu. 2001. The profiles of weekly progesterone and estradiol concentrations during pregnancy in ewes : 2. their correlations with mammary growth indices at parturition. Indonesian Journal of Tropical Agriculture. 10: 24-31

TopoleanuI, D Nadolu and S Zamfirescu. 2008. Ovulatory response to superovulation different treatment in goats. Analele SNBC.8:142-147.

Wiryawan KG, S Suharti and M Bintang. 2005. Kajian Antibakteri *Temulawak*, Jahe dan Bawang Putih terhadap *Salmonella typhimuriam* serta Pengaruh Bawang Putih terhadap Performans dan Respon Imun Ayam Pedaging. Med. Pet. 28:52-62.

Withschi AKM, A Liesegang, S Gebert, GM Weber and C Wenk. 2011. Effect of source and quantity ot dietary vitamin D in maternal and creep diets on bone metabolism and growth in piglets1. J. Anim. Sci. 89:1844-1852.

Yoo DY, K Woosuk, WK Dae and Y Ki-Yeon. 2011. Pyridoxine enhances cell proliferation and neuroblast differentiation by upregulating the gabaergic system in the mouse dentate gyrus. Neurochem Res. 36(5):713.