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Effects of Maternal Nutrition at Different Stages of Pregnancy in Bali Cows on Growth Performance of the Offspring to Weaning

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Abstract**—**The objective of this study was to investigate the life-long effect of in utero nutrition fed at different stages of pregnancy in Bali cows (n = 40): (U1) without in utero nutrition (0 – parturition, negative control); (U2) 0 – 90 d of gestation; (U3) 90 - 180 d of gestation; (U4) 180 d – parturition; and (U5) in utero nutrition along gestation period (0 d to parturition – positive control) on the growth performance of the offspring to weaning age. The results indicated that effect of maternal nutrition on male and female offspring were particularly indicated by the growth performance of both the male and female offspring from birth to weaning.

Keywords**—**Bali cows, birth weight, maternal nutrition, pre-weaning daily gain,weaning weight.

I. Introduction

BALI cattle is one of four existing indigenous cattle breeds (Aceh, Pesisir, Madura and Bali) in Indonesia. Bali cattle was an export commodity to some Asian countries in addition to fulfill local, regional and national requirements of red meat. However, it has been no longer happen since 2-3 decades ago; as continuing over harvesting which resulted in no more stock to fulfill the market standard weight.

Maternal nutrition status during pregnancy is one of extrinsic factors playing a pivotal role in the regulation in utero growth and development of conceptus and placenta, and thereby affects the life-long performance of the offspring [4], [8], [9]. In the past, greater emphasis has been placed on nutrition during late pregnancy, because during this period exponential fetal growth occurs, resulting in a significant increase in the dietary requirements of the animal. Actually, the prenatal growth is sensitive to the direct and indirect effects of maternal dietary intake from the earliest stages of embryonic life, when the nutrient requirements for conceptus growth are negligible. However, in addition to the growth of vascularization, differentiation and organogenesis, the growth of placenta at this stage is exponential [7]. Now, attention is turning to the important role of nutrition earlier in pregnancy [1], [2].

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Accordingly, the objective of the current study is to investigate the effect of maternal nutrition at different stages of pregnancy (early-, mid- and late-pregnancy) of mature Bali cows on growth performance of the offspring up to weaning, as a part of lifelong consequences of *in utero* nutrition.

II. Material and Methods

A total of 40 multiparous Bali cows of 3 and 4 years of age were selected from a group of more than 100 cows and used in the study. The mean ± s.d. of live weight (LW) and body condition score (BCS) of the cows at the start of the study were 282.5 ± 15.3 kg and 3.5, respectively. The animals were divided into 5 groups of 8 animals of *in utero nutrition* treatments, and placed in colony pens; They were (U0) without *in utero* nutrition (0 to paturation – negative control), (U2) 0 to 3 m of gestation, (U3)3 to 6 m of gestation, (U4) 6 to 9 m of gestation, (U5) with *in utero* nutrition (0 – parturition, positive control).

Prior to the commencement of the study, all animals had *ad libitum* access to fresh pasture; All animals were orally dosed with anthelmintic and intramuscularly injected with vitamin B-complex as well as a high dose of vitamin A shortly after placing them in the 5 x 8 m^2 pens.

Basal diet consisted of mixed roughages (60% grass and 40% legume) and concentrate containing 8-9% crude protein. An additional food stuff of *in utero* nutrition treatment or maternal nutrition was 20% of fish meal (60% crude protein) and mixed with the concentrate, and then provided for a total daily consumption of dry matter was about 4% of body weight.

Within 6 d intervals, 8 cows (2 from each treatment group) were submitted to estrus synchronization procedures using prostaglandin injected intramuscularly, which then inseminated using mini straws from one selected Bali bull. Treatments of *in utero* nutrition were applied only to the cows and no further treatments were given to their offspring up to weaning. There were 27 offspring resulted from this breeding program (67.5%) which consisted of 15 male and 12 female distributed in 5 treatments of *in utero* nutrition.

Body weights of the offspring were weighed monthly, and data were analyzed using statistical package of Systat vs. 6 for Window [9].

TABLE I
AMOUNT OF MALE AND FEMALE OFFSPRING FROM EACH TREATMENT OF MATERNAL NUTRITION

Male					Female				
U0	U1	U2	U3	U4	U0	U1	U2	U3	U4
2	4	3	3	3	3	3	2	2	2

III. RESULT AND DISCUSSION

Maternal nutrition exposed at different stages of pregnancy in Bali cows showed an interesting result on growth performance of the offspring, as indicated by their birth, and weaning weights, and their pre-weaning average daily gain (Table II)

Birth weights of male and female offspring of the cows treated at different stages of pregnancy were not significant different; however, birth weights of male or female offspring of U4 were significantly heavier compared with the offspring of the control cows (U0), while birth weights of the other offspring groups were in between U0 and U4.

Weaning weights of the offspring from the treated cows (U1, U2, U3 and U4) were significantly heavier (P<0.05) compared to those from the control cows (U0), either in male and female offspring, and the male offspring were markedly heavier than the female offspring (P<0.01). However, different pregnant stages of *in utero* nutrition on cows were not significantly resulting in different the weaning weights of the male offspring; while weaning weights of the female offspring of U3 and U4 were significant lighter (P<0.05) compared to those of U1 and U2.

Pre-weaning daily gain of male offspring were significantly higher (P<0.01) than those of the female offspring, and these differences were about twice in the offspring from the treated cows compared to those from control cows. However, there were no significant differences in pre-weaning daily gain among different pregnant stages of in utero nutrition treatment, either in male or female offspring.

The maternal nutrition and metabolic environment during pregnancy are critical determining not only the reproductive success of pregnancy but also the long-term performance of the offspring, including growth rate and body composition.

Changes in maternal diet at defined stages of gestation coincident with different stages of development can have pronounced effects on development-growth and function of organ and tissue in later life,

During the first one-half of gestation, maternal nutrition may apparently be unimportant because of the limited nutrient requirements of the conceptus for growth and development. Reference [3] study on ewe reprorted that this is accentuated by the fact that 75% of the growth of the conceptus occurs during the last 2 mo of gestation. However, maximal placental growth, differentiation, and vascularization occur during the early phase, as well as organogenesis, all of which are critical events for normal conceptus development. Recent studies have highlighted the importance of early life events in determining further aspects in postnatal performance [8], [10]. Attributed with organogenesis, it can be interpreted that the treatment of maternal nutrition at different stages of gestation will be manifested by alter the epigenetic state of the fetal genome (stable alterations of gene expression through DNA methylation and histone modifications) [3], [5], [6].

IV. CONCLUSION

1. Maternal nutrition at different stages of gestation did not significantly affect the differences of birth weight between the male and female offspring.
2. Weaning weights of the male offspring were significant heavier compared to those of female offspring.
3. Growth performance Superiorities of the male offspring were particularly resulted from maternal nutrition, as indicated by the higher differences between male and female pre-weaning daily gain of U1, U2, U3, and U4 compared to U0.

Accordingly, to boost the small herder incomes and to improve the rural farmer livelihood in this region, this is a part of the results, and the authors are still continuing doing the research of life-long effects of maternal nutrition to develop economic traits of Bali cattle – in the aspects of reproduction, meat production.

TABLE II
EFFECTS OF MATERNAL NUTRITION AT DIFFERENT STAGES OF PREGNANCY ON THE OFFSPRING BIRTH WEIGHTS AND GROWTH PERFORMANCE TO WEANING

Item		Pregnant stage of maternal nutrition treatment				
		U0	U1	U2	U3	U4
Birth weight (kg)	Male	12.3 ± 0.6 [a]	12.6 ± 0.3 [a]	12.7 ± 0.4 [a]	13.4 ± 0.3 [ab]	13.7± 0.5 [b]
	Female	11.9 ± 0.6 [a]	12.4± 0.8 [a]	12.6 ± 0.5 [ab]	12.9± 0.4 [ab]	13.1± 0.6 [b]
	M vs F	NS	NS	NS	NS	NS
Weaning weight (kg)	Male	57.1 ± 6.6[a]	76.8± 5.3[b]	76.0± 4.3 [b]	74.1 ± 4.9 [b]	78.3± 6.6 [b]
	Female	47.4 ± 4.9 [a]	59.7 ± 5.4 [b]	59.4 ± 5.9 [b]	56.9 ± 4.4 [c]	56.9 ± 3.3 [c]
	M vs F	**	**	**	**	**
Pre-weaning DG (6 moths), (g)	Male	236, 8 ± 17.1[a]	350.9 ± 15.4 [b]	350.6 ± 11.7 [b]	357.2 ± 19.3 [b]	360.8 ± 24.8 [b]
	Female	195.2 ± 21.6[a]	258.8 ± 17.8 [b]	256.4 ± 18.8 [b]	244.4 ±.21.7 [b]	263.3 ± 23.9[b]
	M vs F	**	**	**	**	**

Means within a row with different superscripts differ significantly (P<0.05);NS : non-significant; ** : P<0.01, highly significant

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