CHAPTER VI
SUMMARY AND CONCLUSIONS

1. Growth pattern during post-weaning and pubertal periods in Thai-native goat

A measure of growth pattern of target animals is importance for both producers and breeders in livestock production. Growth pattern provides sequential information of growth *per se*, whereas some growth traits such as birth weight, weaning weight, mature weight and daily gain, are fragmentary aspects of each growing point. Several growth curve models have been used to describe growth patterns of animals. Information on growth pattern is necessary and can be applied to determine feeding and management plans and design breeding strategies to improve capability of whole growth process. Twelve female Thai-native goats were used to study on growth pattern, feed intake and estrous cycle during post-weaning (3-6 months of age) and pubertal period (7-12 months of age)

These data described herein indicates that the growth rate, feed intake and feed conversion ratio were high in post-weaning period and decrease during pubertal period. The growth rate in post-weaning period affected on fertility, first exhibited estrous cycle and had normal cycle. The result of growth rate and feed intake to use as principle data for ART and stair-step feeding in order to induce compensatory growth and enhance health and fertility in Thai-native goats.

2. Induction of multiple follicular development and ovulation in Thai-native goat using FSH and hCG

The assisted reproductive technology (ART) includes artificial insemination, embryo transfer, estrus synchronization and superovulation, multiple ovulation embryo transfer, laparoscopic ovum pick-up, *in vitro* production of embryos, intracytoplasmic sperm injection, cryopreservation of sperm, cryopreservation of oocytes and embryos, sexing of sperm and embryos, embryo splitting, cloning and gene transfer and marker-assisted selection. The goat is an excellent model for all these ARTs and has been used extensively in both basic and applied researches. The applications of these ARTs in goats enable to increase the rate of genetic progress,

reduce generation interval and enhance production. Thai-native non pregnant goats (n=16; 14 months of age) received of two treatments: 2 days FSH (FSH-P; Folltropin-v®; 2D-FSH) and 3 days FSH (3D-FSH). Group of 2D-FSH was intramuscularly injected with twice daily FSH for 2 days (18 mg), starting on Day 18, 19 and with 300 IU hCG (Chorulon®) on Day 20 of estrous cycle.

In summary, the majority of ovulation in Thai-native goat using FSH and hCG occurred between 24 and 72h. These results indicate that superovulation with a decreasing dose of FSH (3D-FSH) and 300 IU hCG can be an effective protocol for Thai-native goat superovulation.

3. Effect of stair-step feeding regimen during estrous cycle on fertility of Thai-native goats

A stair-step feeding regimen that is a combination of alternating dietary energy restriction and realimentation phases. The basic concept of this model is to exploit the biological nature of both dietary energy restriction and the compensatory growth phenomenon in concert with one or more hormone dependent allometric phases of body composition development. Energy restriction has a profound influence on the biology and health of animals including the retardation of aging and the reduction of cancer incidence and other late-life diseases. Through modulation of endocrine and enzymatic status, energy restriction shifts the physiological focus to energy-conserving activities, mainly maintenance and repair functions, and decreases certain energy-wasteful metabolic pathways that are not essential for growth. Realimentation after energy restriction induces compensatory growth, which is characterized by an accelerated anabolism, a reduced maintenance requirement, an activated endocrine status, and an altered tissue composition. Sixteen Thai-native non pregnant goats were used to study. The does exhibited at least normal 2 estrous cycles and were housed in 1 m^2 steel cages. Heat detection was twice daily recorded using a vasectomized buck. The female goats were randomly assigned into two groups: Control and Stair-step feeding group.

In conclusion, the application of compensatory growth using stair-step feeding regimen during estrous cycle. The results found that average total feed intake, average daily gain and feed conversion ratio were not statistically different between

stair-step and control group. However, the stair-step feeding regimen in order to induce compensatory growth on oocytes quality, follicular development and the labeling index in granulosa and theca layer of follicle greater than control group. Thus, the results indicate that reproductive management in pubertal and pre-gestation periods using stair-step feeding regimen affects fertility improvement in Thai-native goats.

4. Future research directions

Until now, a little study has focused on describing principle of compensatory growth and ART in small ruminant such as sheep and goat. Knowledge and information of ART and compensatory growth application (using stair-step feeding regimen) are important for on reproductive management in small ruminant production. These technologies and reproductive management may lead to an improvement of fertility in goats. Therefore, the better understanding of applies reproductive management information is a prerequisite in order to consider or choose the optimizing protocol for improvement of fertility in goat.

Recently, the ART are being used for the improvement and preservation of livestock genetics and the enhancement of reproductive efficiency. The applications ART in goats enable to increase the rate of genetic progress, reduce generation interval and enhance production.

In goats, superovulatory treatment typically consists of a combination of estrous cycle control (usually involving application of progestagen implants) with an elevated dose of a gonadotropin, to induce the ovary to release more than the typical number of oocytes. However, in present study we tested the goats treated with FSH (FSH decreasing dose, 2 days compared with 3 days protocols) and hCG without progestagen implants has sufficient effects on follicular development and ovulation. This potocols saves on labour and expense, and has been adopted by a number of commercial embryo transfer operations. We know that there is a requirement that all animals subjected to a TAI protocol have a healthy dominant and estrogen active follicle at the end of the treatment. Thus, a better understanding of hormone control of follicular growth is a prerequisite in order to obtain more precise control of the

follicular growth and ovulation, allowing one AI at a predetermined time giving high conception rates without the need of estrus detection.

Several observations in this dissertation have contributed to our understanding of the stair-step feeding regimen. The nutrition regimen that is a combination of alternating dietary energy restriction and realimentation phases. The basic concept of this model is to exploit the biological nature of both dietary energy restriction and the compensatory growth phenomenon in concert with one or more hormone dependent allometric phases of estrous cycle. Energy restriction has a profound influence on the biology of animals. Energy restriction shifts the physiological focus to energy-conserving activities, mainly maintenance and repair functions, and decreases certain energy-wasteful metabolic pathways that are not essential for growth. Realimentation (refeeding) after energy restriction induces compensatory growth, which is characterized by an accelerated anabolism, a reduced maintenance requirement, an activated endocrine status, and an altered tissue composition. Compensatory growth enhances the efficiency of general body development and induces hyperplasia and hypertrophy of reproductive tissues. We tested the theory that the stair-step feeding regimen during estrous cycles has effects on follicular development, oocytes quality, blood metabolites, hormonal change, expression of PCNA and Bcl-2 gene in follicle. Little is known, however, about the compensatory growth (using stair-step feeding regimen) that promote and maintain the proliferation of preovulatory follicles. Although the observations described herein suggest that PCNA and Bcl-2 gene may be important in promoting proliferation and oocytes quality of the preovulatory follicles.

Therefore, future research should apply the stair-step feeding regimen in first lactating dairy cows because these cows are still growing and may obviously affect the compensatory growth and production.

Development of methods for stair-step feeding regimen to focus optimum time of fed animal (during a period of restriction and realimentation) in pre-pubertal, pubertal and gestation is an important methods that should enable compensatory growth phenomenon of reproductive tissue. Biological assay of intrafollicular factors or their activity will provide the basis for us to understand some of the mechanisms involved. In addition, changes in intrafollicular factors, proteins, and genes likely are

important to folliculogenesis, atresia, and ovulation in ovarian follicular growth and differentiation.

Compensatory growth could be modified with the use of ART in order to improve the fertility in farm animal species. However, the modification should be conducted in laboratory animals (rat or mice) due to less investment and shorter life-span or longevity. Superovulation using 3D-FSH in animal fed stair-step regime will enhance the response of follicular growth and development during pre-and pubertal period.