



**UNIVERSITI PUTRA MALAYSIA**

**EFFECT OF PALM KERNEL CAKE BASED DIET ON LIBIDO AND  
SEMEN QUALITY OF MALIN X SANTA-INES LAMBS**

**ZELEALEM TESFAY GEBRETSADIK.**

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QUALITY OF MALIN x SANTA-INES LAMBS**

**By**

**ZELEALEM TEFAY GEBRETSADIK**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra  
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Agricultural Science**

**January 2004**



## **DEDICATION**

**This thesis is dedicated to the people of ETHIOPIA. I owe my country a great debt.**



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Agricultural Science

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By

**ZELEALEM TEFAY GEBRETSADIK**

**January 2004**

**Chairman: Associate Professor Ismail Bin Idris, Ph.D.**

**Faculty: Agriculture**

A study was conducted for six months at the farm of the Department of Animal Science, Universiti Putra Malaysia (UPM), Serdang, Selangor (3° 00' N, 101° 42' E) to investigate the effect of palm kernel cake based diet on serving capacity and semen quality of Malin x Santa-Ines crossbred ram lambs. Twenty Malin x Santa-Ines crossbred ram lambs were randomly assigned into three dietary treatments namely (T1) 60% Palm kernel cake + 40% oil palm frond, (T2) 60% Palm kernel cake + 40% oil palm frond supplemented with 23 mg/kg dry matter of molybdenum as ammonium molybdate ((NH<sub>4</sub>)<sub>6</sub>Mo<sub>7</sub>O<sub>24</sub>·4H<sub>2</sub>O) and 600mg/kg dry matter of Sulfur as sodium sulphate (Na<sub>2</sub>SO<sub>4</sub>) and (T3) control; 60% concentrate of corn-soybean mix + 40% oil



palm frond. There was no significant difference ( $p>0.05$ ) among the rams for the three dietary treatments for libido or mating behavior. All rams reached their optimum mating behavior (number of ejaculation =  $6.7\pm 1.3$  and mating efficiency =  $0.43\pm 0.01$ ) after the second month of the experiment. It was also found that there was no significant difference ( $p>0.05$ ) for all the semen quality parameters among the rams under the three dietary treatments. Rams in all dietary treatments produced good semen and their sperm characteristics were within the ranges for good rams (semen volume = 0.7-2.0 ml; sperm concentration =  $2-5 \times 10^9$  cells/ml; sperm motility > 80%; percentage of abnormal morphology <15%).

Although there was a significant difference on the level of copper (Cu) accumulated in the liver ( $p<0.01$ ) and testis ( $p<0.05$ ), with highest values in rams under T1 ( $1089 \pm 189$  ppm and  $0.63 \pm 0.18$  ppm, respectively), there was no symptom of toxicity observed in the rams. Therefore, it was concluded that PKC has no negative effect on serving capacity and semen quality of Malin x Santa-Ines crossbred sheep, at least for six months of the feeding period. It was also concluded that supplementing 23 mg/kg dry matter of Molybdenum and 600 mg/kg dry matter Sulphur to sheep fed on PKC based diet helps to protect Cu accumulation in the plasma, liver and testis of rams without negative effect on their reproductive capacity and semen quality.



Even though higher serum testosterone was found in rams under diets T1 and T2 compared to T3, this did not reflect the actual reproductive level and sperm quality. Hence, it was concluded that serum testosterone level might not be a good indicator of reproductive performance of rams when blood samples are taken from conscious animals.



**Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan ijazah Mster Sains Pertanian**

**KESAN DIET ASAS ISIRONG KELAPA SAWIT KE ATAS LIBIDO DAN  
KUALITI SEMEN ANAK BIRI-BIRI BAKA KACUKAN MALIN x SANTA-INES**

**Oleh**

**ZELEALEM TEFAY GEBRETSADIK**

**Januari 2004**

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Satu Kajian telah dijalankan selama enam bulan di ladang Jabatan Sains Haiwan, Universiti Putra Malaysia (UPM), Serdang, Selangor (3° 00' Utara, 101° 42' Timur) untuk menyelidik kesan isirong kelapa sawit (PKC) sebagai diet asas ke atas keupayaan mengawan dan kualiti semen biri-biri baka kacukan Malin x Santa-Ines. Dua puluh ekor biri-biri Malin x Santa-Ines telah ditentukan secara rawak kepada tiga rawatan diet iaitu (T1) 60% PKC + 40% pelet pelepah kelapa sawit, (T2) 60% PKC + 40% pelet pelepah kelapa sawit di suplemen dengan 23 mg/kg berat kering molybdenum sebagai ammonium molybdate ((NH<sub>4</sub>)<sub>6</sub>Mo<sub>7</sub>O<sub>24</sub>.4H<sub>2</sub>O) dan 600 mg/kg berat kering sulfur sebagai sodium sulfat



(Na<sub>2</sub>SO<sub>4</sub>) dan (T3) kawalan; 60% konsentrat mengandungi campuran jagung-kacang soya + 40% pelet pelepah kelapa sawit. Tiada perbezaan bererti ( $p > 0.05$ ) diantara biri-biri jantan pada ketiga-tiga rawatan diet untuk 'libido' atau kelakuan mengawan. Semua biri-biri jantan mencapai kelakuan mengawan yang optimum (bilangan ejakulasi =  $6.7 \pm 1.3$  dan efisiensi mengawan =  $0.43 \pm 0.01$ ) selepas dua bulan kajian dijalankan. Tiada perbezaan bererti ( $p > 0.05$ ) juga didapati untuk semua parameter kualiti semen diantara biri-biri jantan untuk ketiga-tiga rawatan diet. Biri-biri jantan dalam semua rawatan diet menghasilkan semen yang berkualiti dan ciri-ciri sperma yang dihasilkan adalah dalam julat untuk biri-biri jantan yang baik (isipadu semen =  $0.7-0.2$  ml; kepekatan sperma =  $2-5 \times 10^9$  sel/ml; motiliti sperma  $> 80\%$ ; peratusan morfologi sperma abnormal  $< 15\%$ ).

Walau bagaimanapun, terdapat perbezaan bererti pada tahap kuprum terkumpul dalam hati ( $p < 0.01$ ) dan testis ( $p < 0.05$ ), dengan nilai yang tertinggi bagi biri-biri jantan di bawah T1 ( $1089 \pm 189$  ppm dan  $0.63 \pm 0.18$ , masing-masing), tidak terdapat simptom keracunan pada biri-biri jantan. Oleh yang demikian, dapat dirumuskan bahawa tiada kesan negatif PKC ke atas keupayaan mengawan dan kualiti semen biri-biri jantan baka kacukan Malin x Santa-Ines, sekurang-kurangnya untuk jangkamasa pemakanan selama enam bulan. Ia juga dapat dirumuskan bahawa dengan memberi suplemen 23 mg/kg berat kering molybdenum dan 600 mg/kg berat kering sulfur kepada biri-biri yang diberi PKC sebagai diet asas akan menolong melindungi pengumpulan



Cu di dalam plasma, hati dan testis biri-biri jantan tanpa kesan negatif terhadap keupayaan reproduktif dan kualiti semen.

Walaupun testosteron dalam serum didapati tinggi pada biri-biri jantan di bawah T1 dan T2 berbanding T3 ini tidak menggambarkan tahap reproduktif sebenar dan kualiti sperma. Oleh itu, ia dapat dirumuskan bahawa tahap testosterone dalam serum mungkin merupakan petunjuk yang kurang baik bagi prestasi reproduktif biri-biri jantan apabila sampel darah diambil daripada haiwan yang sedar.



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## ABBREVIATIONS

The following abbreviations are used in the thesis with or without definition.

|                   |                              |
|-------------------|------------------------------|
| ANOVA             | Analysis of variance         |
| ATP               | Adenosine triphosphate       |
| Ca                | Calcium                      |
| CONC              | Concentrate                  |
| CRD               | Completely randomized design |
| Cu                | Copper                       |
| Cu <sub>2</sub> O | Cuprous oxide                |
| CV                | Coefficient of variation     |
| DI                | Deciliter                    |
| DM                | Dry matter                   |
| EIA               | Enzyme immuno assay          |
| EJA               | Ejaculations                 |
| EMS               | Error mean squares           |
| Fe                | Iron                         |
| GLM               | General linear model         |
| H                 | Hour                         |
| ICP               | Inductively coupled plasma   |
| K                 | Potassium                    |
| LFE               | Latency to first ejaculation |
| LFM               | Latency to first mount       |





|        |                             |
|--------|-----------------------------|
| LH     | Lutienizing hormone         |
| MEFF   | Mating efficiency           |
| Mo     | Molybdenum                  |
| Mol    | Moles                       |
| MPOB   | Malaysian Palm Oil Board    |
| ng     | Nano gram                   |
| Nmol/l | Nano mole per liter         |
| NRC    | National research council   |
| NS     | Non significant             |
| °C     | Degree Celsius              |
| OPF    | Oil palm frond              |
| p      | Probability                 |
| PBS    | Phosphate Buffer Saline     |
| PKC    | Palm kernel cake            |
| ppm    | Parts per million           |
| r      | Correlation coefficient     |
| REF    | Refractory period           |
| RPM    | Revolution per minute       |
| S      | Sulphur                     |
| SAS    | Statistical analysis system |
| SD     | Standard deviation          |
| SE     | Standard error              |
| S-Mo   | Sulphur molybdenum complex  |



|        |                           |
|--------|---------------------------|
| t test | Students t-test           |
| TCA    | Trichloroacetic acid      |
| UPM    | Universiti Putra Malaysia |
| Zn     | Zinc                      |

# CHAPTER 1

## INTRODUCTION

The small ruminant production systems in Malaysia can be described as extensive, intensive, semi-intensive and animal tree-crop integration systems (Rajion *et al.*, 1993). Integration of ruminants with tree-crops is the most practical and widely practiced production system by many government and private farms. Integration of small ruminants, specifically sheep, in oil palm plantation has been successful (Rajion *et al.*, 1994), though the herbage under the plantation does not support the animals' maintenance requirement in quantity and quality.

Sheep population in Malaysia has showed an increasing trend for the last 30 years (Appendix A). This is due to their feeding habit, the ease to integrate them with oil palm or rubber plantations and the liberal importation of exotic breed and crossing or upgrading program (Abdullah Sani *et al.*, 1999).

The success of a sheep production enterprise is highly dependent, among others on the ability of rams to breed maximum number of ewes, which is a factor of libido and mating ability of the rams. Reproductive inefficiency in sheep results in reduced dissemination of superior genetic material and lower producer profitability. The existence of a large number of low libido rams in a



flock will have a negative impact on flock productivity and profitability by causing longer lambing interval and creating the need to keep many rams. This problem may be more pronounced in small farm households where it is uneconomical to keep less productive male animals for a long period.

Libido in sheep, as in all other animals, is influenced by factors such as genotype, nutrition, climate, health of animals and farm management practices. Nutritional manipulation/fluctuation, in particular trace elements, has a major influence in libido expression in animals (Martin and White, 1992; Puls, 1994). This can be induced through antagonistic interaction, toxicity and deficiency of the trace elements.

Among the trace elements, copper (Cu) has been reported to have a significant role in influencing the fertility of farm animals, being constituent of many enzymes and hormones (Davis and Mertz, 1987; Linder and Hazegh-Azam, 1996; Underwood and Suttle, 1999). Therefore, it is important to include high Cu feed source in animal rations. Palm kernel cake (PKC), a known by-product of the oil palm industry in Malaysia can be used in this regard as it has high Cu content. Palm kernel cake is a widely used feed supplement in Malaysia with considerable export potential (MPOB, 2002). The production of PKC by palm oil industry in Malaysia is increasing year after year. The production in 2000 was 1.3 million metric tones while that of 2001



was 1.8 million metric tones. The nutrient content of PKC makes it suitable for most ruminant animals. However, its Cu content makes it less suitable for sheep because a concentration as low as 10 ppm of Cu in the feed is said to be toxic to sheep (Church and Pond, 1988).

Previous research work have showed that Cu deficiency can cause infertility and delayed estrus in cattle and sheep (Underwood, 1977; Puls, 1994). Rams fed with Cu deficient diet were found to be less successful in breeding ewes (Weiner and Sales, 1976). This indicates how Cu is important for normal reproductive function of animals. However, information on the effect of excessive Cu on reproduction is lacking.

### **General Objective**

- To evaluate the effect of high level of palm kernel cake diet on serving capacity and semen quality of ram lambs.

### **Specific Objectives**

1. To investigate the effects of PKC (higher Cu diet) on serving capacity and sperm quality of ram lambs.
2. To investigate the effect of PKC (high Cu diet) on plasma Cu and serum testosterone levels in ram lambs



3. To investigate the controlling effect of Molybdenum (Mo) and Sulphur (S) supplemented to PKC based diet on plasma, liver and testis Cu level in ram lambs.