นิพนธ์ต้นฉบับ

Growth and Carcass Composition of Dorset x Siamese Long Tail and Dorset x Malin Sheep in Feedlot System

Key words : Growth performance, Carcass composition, 25%Dorset x 75%Siamese Long Tail, 25%Dorset x 75%Malin, Feedlot

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Abstract

The objective of this study was to compare the growth performance and carcass composition of the DSLT with DMalin sheep under *ad libitum* of Guinea grass and 2% live weight of concentrate diet under the feedlot system. Fifteen heads of each male and female of the DSLT (25% Dorset x 75% Siamese Long Tail) and the DMalin (25% Dorset x 75% Malaysian Indigenous breed) sheep at about five months of age with 12.5 $\pm$ 1.1 kg of live weight were randomly allotted into a 2 x 2 factorial arrangement in completely randomised design. Factor A were 2 breed combinations (DSLT and DMalin sheep) and factor B were 2 sexes (male and female). During 120 days of the experimental study, sheep were fed with Guinea grass (Panicum maximum cv. Common Guinea) *ad libitum* and 2% of live weight/day of concentrate diet (15.7% CP and 12.7 MJ/kg DM). From the study, no interaction ($P>0.05$) between sheep breed and sex were detected for any of the measurements evaluated. It was observed that the average dry mater intake (DMI) of the DSLT and DMalin sheep was 66.0 and 64.9 g/kg$^{0.75}$/day, in that order ($P>0.05$). The DSLT had a similar metabolisable energy intake (MEI) to the DMalin sheep (0.72 vs. 0.71 MJ ME/kg$^{0.75}$/day; $P>0.05$). There was no significantly difference in the DMI and MEI between the male and female sheep (66.0 vs. 64.3 g/kg$^{0.75}$/day and 0.73 vs. 0.71 MJ ME/kg$^{0.75}$/day; $P>0.05$). For the growth rate, the DSLT performed slightly faster than the DMalin sheep (108.1 and 98.3 g/head/day; $P>0.05$). The males gained 26.2% faster than the females (118.8 vs. 87.7 g/day; $P<0.05$). There was no significant difference in the dressing percentage of the DSLT and DMalin sheep (50.5 and 51.9%). The males tended to have lower dressing percentage than the female sheep (48.8 vs. 52.0%; $P>0.05$). In terms of carcass composition, the DSLT had no significant difference in muscle and bone percentages (62.3 vs. 57.0% of muscle and 20.5 vs. 20.3% of bone, respectively) but had a significantly lower in fat percentage than the DMalin sheep (17.1 vs. 22.8%). The male sheep showed a significantly

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higher in muscle percentage but had a lower fat percentage than the females (61.0 vs. 56.2%; 16.7 vs. 23.1%). Both sexes had a similar bone percentage (23.3 vs. 23.0%). There was no significantly difference in muscle : fat ratio between the DSLT and DMalin sheep (3.4 vs. 2.6; P>0.05). In addition, both breed sheep showed non-significant difference in muscle : bone ratio (1.4 vs. 2.7). The DSLT showed a similar fat thickness and rib eye area to the DMalin sheep (2.5 vs. 2.4 mm. and 8.6 vs. 7.8 cm^2; P>0.05). There was no significant difference in fat thickness at the 12^{th} rib and rib eye area between male and female sheep (2.5 vs. 2.3 mm. and 8.4 vs. 8.0 cm^2; P>0.05).

บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อเปรียบเทียบสมรรถนะการเจริญเติบโตและส่วนประกอบของซากของแกะลูกผสม 25% Dorset x 75%Siamese Long Tail (DSLT) และแกะลูกผสม 25% Dorset x 75% Malaysian Indigenous (DMalin) ที่เลี้ยงแบบขุนโดยให้หญ้ากินนีอย่างไม่จำกัดและเสริมด้วยอาหารข้นในปริมาณร้อยละ 2 ของน้ำหนักตัว โดยสุ่มเลือกแกะทั้งสองสายพันธุ์ที่มีอายุประมาณ 5 เดือน และมีน้ำหนักตัวประมาณ 12.5 ± 1.1 กิโลกรัม เพศละ 15 ตัว เข้าศึกษาโดยวิธีแฟคตอเรียลตามแผนการทดลองแบบสุ่มตลอด กำหนดให้ปัจจัยที่ 1 คือ สายพันธุ์แกะ 2 สายพันธุ์ (แกะลูกผสม DSLT และ DMalin) และปัจจัยที่ 2 คือ เพศ (เพศผู้ และเมีย) ในช่วงระยะเวลาทดลองนาน 120 วัน แกะทุกตัวได้รับหญ้ากินนี (*Panicum maximum* cv. Common Guinea) อย่างเต็มที่ (*ad libitum*) และได้รับอาหารข้น (มีระดับโปรตีนร้อยละ 15.7 และพลังงานที่ใช้ประโยชน์ได้ เท่ากับ 12.7 เมกกะจูล/กก. วัตถุแห้ง) ในปริมาณร้อยละ 2 ของน้ำหนักมีชีวิต จากการศึกษา ไม่พบความแตกต่างทางสถิติในอันตรกริยาระหว่างสายพันธุ์แกะกับเพศในการศึกษาข้อมูลด้านต่าง ๆ ทั้งนี้แกะ ลูกผสม DSLT และ DMalin มีปริมาณวัตถุแห้งที่กินได้ (dry matter intake) เฉลี่ยเท่ากับ 66.0 and 64.9 กรัม/กก.$^{0.75}$/วัน ตามลำดับ (P>0.05) และได้รับปริมาณพลังงานที่ใช้ประโยชน์ได้ (metabolisable energy intake) ซึ่งสัตว์กินได้ใกล้เคียงกับแกะลูกผสม DMalin (0.72 และ 0.71 เมกกะจูลของพลังงานที่ใช้ประโยชน์ได้/กก.$^{0.75}$/วัน; P>0.05) ทั้งนี้แกะเพศผู้และเพศเมียมีปริมาณวัตถุแห้งที่กินได้และปริมาณพลังงานที่ใช้ประโยชน์ได้ไม่แตกต่างกันทางสถิติ (66.0 และ 64.3 กรัม/กก.$^{0.75}$/วัน; 0.73 และ 0.71 เมกกะจูลของพลังงานที่ใช้ประโยชน์ได้/กก.$^{0.75}$/วัน; P>0.05) แกะลูกผสม DSLT อัตราการเจริญเติบโตค่อนข้างสูงกว่าแกะลูกผสม DMalin (108.1 และ 98.3 กรัม/ตัว/วัน; P>0.05) โดยแกะเพศผู้มีอัตราการเจริญเติบโตดีกว่าแกะเพศเมียร้อยละ 26.2 (118.8 vs. 87.7 กรัม/วัน; P<0.05) ในส่วนน้ำหนักซากเมื่อคิดเป็นร้อยละของน้ำหนักมีชีวิต พบว่าแกะลูกผสม DSLT มีน้ำหนักซากเมื่อคิดเป็นร้อยละไม่แตกต่างจากแกะลูกผสม DMalin (ร้อยละ 50.5 และ 51.9 ตามลำดับ; P>0.05) สำหรับส่วนประกอบของซาก พบว่าแกะลูกผสม DSLT และ DMalin มีปริมาณเนื้อแดงและกระดูกไม่แตกต่างกันทางสถิติ (เนื้อแดงร้อยละ 62.3 และ 57.0; กระดูกร้อยละ 20.5 และ 20.3 ตามลำดับ) แต่แกะลูกผสม DSLT มีปริมาณไขมันเมื่อคิดเป็นร้อยละต่ำกว่าแกะลูกผสม DMalin อย่างมีนัยสำคัญทางสถิติ (ร้อยละ 17.1 และ 22.8; P<0.05) ทั้งนี้ซากแกะเพศผู้มีปริมาณกล้ามเนื้อเมื่อคิดเป็นร้อยละสูงกว่า แต่มีปริมาณไขมันเมื่อคิดเป็นร้อยละน้อยกว่าแกะเพศเมีย (61.0 และ 56.2%; 16.7 และ 23.1% ตามลำดับ P<0.05) อย่างไรก็ตามแกะทั้งสองเพศมีปริมาณกระดูกเมื่อคิดเป็นร้อยละไม่แตกต่างกัน (ร้อยละ 23.3 และ 23.0; P>0.05) แกะลูกผสม DSLT และ DMalin มีอัตราส่วนระหว่างกล้ามเนื้อต่อไขมันไม่แตกต่างกัน (3.4 และ 2.6; P>0.05) รวมทั้งแกะทั้งสองสายพันธุ์ยังมีอัตราส่วนระหว่างกล้ามเนื้อต่อกระดูกไม่แตกต่างกันด้วย (1.4 และ 2.7; P>0.05) แกะลูกผสม DSLT มีความหนาของไขมันที่สันที่ตำแหน่งซี่โครงที่ 12 และพื้นที่

หน้าตัดสันใกล้เคียงกับแกะลูกผสม DMalin (2.5 และ 2.4 มม.; 8.6 และ 7.8 ซม.^{2}; P>0.05) ทั้งนี้ความแตกต่างระหว่างเพศไม่มีผลทำให้ความหนาไขมันสันและพื้นที่หน้าตัดสันแตกต่างกันทางสถิติ (2.5 และ 2.3 มม.; 8.4 และ 8.0 ซม.^{2}; P>0.05).

Introduction

Local sheep breed, Malaysian Indigenous sheep (Malin) is a small slow growing either in village or intensive system (Tajuddin and Chong, 1988; Davis et al., 1993). Thus, exotic breeds of sheep have been imported and crossed with local sheep in order to improve the body size and productivity of local sheep (Abdul Wahid, 1994; Rajion et al., 1993). However, among the exotic sheep breeds, Dorset being tolerant and appear to be better acclimatized in Malaysian environment (Mukherjee, 1994). This exotic breed was then selected to cross with the Malin sheep for the Malaysian prime lamb (Ariff et al., 1994). In addition, the Siamese Long Tail sheep (SLT), a tropical sheep breed, have also been imported to Malaysian mainly to improve the Malaysian sheep breeds (Mukherjee, 1994). In comparison studies using the Malin, SLT and Dorset x Malin (DMalin) sheep, the Malin were 23% and 3% more prolific, 67% and 33% more heavier birth weight than the SLT and DMalin sheep. In addition, the Dorset x Malin showed the best live weight gain after weaning followed by the SLT and Malin sheep (Khusahry et al., 1993). When compare the growth performance of the DMalin with the Dorset x Siamese Long Tail (DSLT) sheep, Wattanachant et al. (1997) reported that under integration in oil palm plantation system the DSLT showed better growth performance than the DMalin sheep. However, due to the growth and carcass performances of the Dorset crossed with the SLT and Malin sheep in feedlot system was limited, the purposes of this study was to determine the growth performance and carcass composition of the DSLT with DMalin sheep under *ad libitum* of Guinea grass and 2% live weight of concentrate diet under the feedlot system. The information gained will be beneficial for the further development programme for the suitable limb production for Malaysia and other tropical humid countries.

Materials and Methods

Location of study

This study was conducted on the research station at the Department of Animal Science, Universiti Putra Malaysia (UPM), Serdang, Selangor, Malaysia.

Animals and their management

Fifteen heads of each male and female of the 25% Dorset x 75% Siamese (Thai) Long Tail (DSLT) and 25% Dorset x 75% Malaysian Indigenous (DMalin) sheep at about five months old with 12.5 $\pm$ 1.1 kg were randomly selected into 2 x 2 factorial arrangement in CRD. Animals were transferred from the Far East Holdings Berhad (FEH) farm, Pahang State.

During thirty days of the adjustment period, sheep were de-wormed (thiabanazol) and treated with A, D_3 and E vitamin. They were weighed, tagged and grouped according to the breed and sex into fifteen heads per each group. Animals were fed with Guinea grass (*Panicum maximum* cv. Common Guinea) *ad libitum* through a cut and carry system and supplemented with concentrate feed at the rate of 100 g/head/day. During one hundred and twenty days of the experimental period, feed was provided to the sheep as a group feeding system. Guinea grass was fed *ad libitum* through

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a cut and carry system and concentrate diet was also given at the rate of 2.0% of live weight (LW)/day. Furthermore, mineral block was also provided for the lambs. The nutrient composition of both roughage and concentrate feed is shown in Table 1.

Data Collection

Feed intake was determined by offering weighed quantities of feeds (roughage and concentrate diet) and the weighing back of the daily refusals after 24 hours of consumption. This determination of feed intake was done every seven days at the end of the month and continuously until the end of the experiment. The live weight of sheep at 24 hours starved was individually recorded every 2 weeks.

Carcass composition

Five sheep per group were sampled and slaughtered according to the procedure described by Yacob (1994) at the Meat Lab., UPM. The left halves of carcasses were dissected into muscle fat and bone using the technique of described by Berg and Butterfield 1963 (cited by Hilmi, 1975). Fat thickness and rib eye area at the 12^{th} rib was determined according to Taylor and Field (1998).

Chemical Analyses

Feed samples were determined according to AOAC (1990) procedures.

Statistical Analysis

Analysis of variance of each parameter was carried out according to the method described by Steel and Torrie (1980). All statistical analysis was performed according to SAS (1988).

Results and Discussion

Dry matter intake, metabolisable energy intake and Feed conversion ratio

As shown in Table 2, the mean values of dry matter intake (DMI) per metabolic weight of

Table 1 Nutrient composition of roughage and concentrate feed used for the feedlot system

Items	Percentage	
	Roughage 1/	Concentrate 2/ 3/
Dry matter (DM), %	25.3	92.2
CP, % of DM	8.5	15.7
CF, % of DM	35.9	6.1
EE, % of DM	1.4	5.8
Ash, % of DM	7.2	6.2
NFE, % of DM	47.0	66.2
GE, MJ/kg DM	17.1	16.9
ME, MJ/kg DM4/	8.0	12.7

1/ Means of 10 grass samples (leaf and stem) that were sampled every 14-days during the experiment; 2/ Means from 6 batches; 3/ containing as fed basis: 51.7% ground corn, 29.2% rice bran; 16.5% soy bean meal, 0.27% NaCl, 2.73% limestone and 0.18% minerals; 4/ ME (calculated from 4.184 * (0.036154 * %TDN))

DSLT in this study tended to be higher than that of the DMalin sheep (66.0 vs. 64.9 $g/kg^{0.75}$/day; P>0.05). The males showed slightly higher DMI per metabolic weight than the females (66.0 vs. 64.3 $g/kg^{0.75}$/day; P>0.05).

From this study, the average DMI of sheep was 65.1 $g/kg^{0.75}$/day or 3.2% of LW. This data was similar to the report of Yacob (1994) who fed the DMalin sheep with sweet corn stover silage and concentrate supplement. The result of the DMI of sheep found in this study was in the range of DMI estimated from the nutrient requirements of sheep in the tropics as described by Kearl (1982). Nevertheless, it was lower than the report of Andrew and Ørskor (1970) probably due to the effect of the hot climate environment to the feed intake of the sheep. Thus, Owen (1976) stated that sheep reared under hot climate show lower DMI than those raised under temperate environment. This was also in an agreement with Bruce (1993).

In terms of metabolisable energy intake (MEI), it was found that the DSLT had a similar MEI to the DMalin sheep (0.72 and 0.71 MJ ME/$kg^{0.75}$/day; P>0.05). The male had a slightly higher than the female (073 vs. 0.71 MJ ME/$kg^{0.75}$/day, respectively). The overall average of MEI of sheep was 0.71 MJ ME/$kg^{0.75}$/day which was in the range of MEI estimated from the nutrient requirements of sheep in the tropics as described by Kearl (1982).

For the FCR, it was found that the DSLT and DMalin sheep were 5.6 and 6.7 respectively (P<0.05). The males showed a significantly better FCR than the females (5.2 and 6.2; P<0.05). The overall FCR of sheep in this study was slightly better than the report of Yahya et al. (1996) who fed the DMalin crossbred sheep with 64.4% sago pith meal (5.7 vs. 6.3).

Growth performance

Data on live weight change at 0, 2, 4 and 6 month of the experiment were 13.0, 16.3, 18.9, 22.4 and 26.0 kg for the DSLT and 12, 15.1, 16.8, 20.5 and 23.8 kg, in that order (P>0.05). The average daily gain (ADG) of the DSLT and DMalin sheep is shown in Table 2.

From this study, there was no significant difference in the average live weight change of the DSLT and DMalin sheep (108.1 and 98.3 g/head/day or 9.4 vs. 9.1 $g/kg^{0.75}$/day; P>0.05). In both breeds, the males grew significantly faster than the female sheep (118.8 and 87.7 g/head/day; P<0.05). The overall ADG of the sheep was 103.2 g/head/day (9.3 $g/kg^{0.75}$/day).

The live weight change of the DSLT sheep was nearly the same as reported by Basery et al. (1993) who reared the sheep in the feedlot system (108.1 vs. 109 g/head/day or 10.0 vs. 8.7 $g/kg^{0.75}$/day). However, the ADG of the DMalin sheep was about 15.9% lower than the report of Davis et al. (1996) who fed the sheep with grass-free palm kernal cake diet. The ADG of the DMalin was also lower than the report of Yahya et al. (1996) (98.3 vs. 114 and 122 g/head/day). The lower of live weight gain of sheep in this study may probably related to the physical type of roughage (leaf and stem) and the levels of protein in the concentrated supplementation. From the study, the male showed better live weight gain than the female P<0.05). This was probably associated with the influence of hormones that control the body composition, particularly, growth hormone (Prescott, 1978; Berg and Butterfield, 1976; Early et al., 1990). However, based on the metabolic live weight, the live weight gain of the DSLT showed no significant difference with the DMalin sheep (9.9 vs. 8.5 g/$kg^{0.75}$/day).

Table 2 $\overline{X}\pm$ SD of DMI, MEI, live weight, ADG and FCR of the DSLT and DMalin sheep in the feedlot system

Items		DMI (g/kg$^{0.75}$/day)	MEI (MJ/kg$^{0.75}$/day)	Live Weight (kg)		ADG		FCR
				Initial	Final	g/day	g/kg$^{0.75}$/d	
Breeds	DSLT	66.0±1.8	0.72±0.04	13.0±2.0	26.0±2.5	108.1±26.0	10.0±2.1	5.5±0.85
	DMalin	64.9±1.8	0.71±0.03	12.0±1.5	23.6±3.6	98.3±22.5	8.7±1.7	6.7±0.89
	LS[1/]	NS	NS[2/]	NS	NS	NS	NS	NS
Sexes	Male	66.0±2.7	0.73±0.09	13.2±1.2	27.5±3.0	118.8±7.8	9.8±1.6	5.2±0.01
	Female	64.3±2.4	0.71±0.10	11.8±0.9	22.1±1.9	87.7±8.5	8.4±2.0	6.2±0.08
	LS	NS	NS	NS	0.05	0.05	NS	0.05
Average		65.1±3.0	0.71±0.03	12.5±1.1	24.8±3.7	103.2±18.8	9.3±1.8	5.7±0.93

1/ LS = level of significant; 2/ = non significant difference

Table 3 $\overline{X}\pm$ SD of carcass's chemical composition and carcass composition of the DSLT and DMalin sheep in the feedlot system

Items		Carcass composition [1/]							FT (mm)[7/]	REA (cm^2)[8/]	M/F Ratio[9/]	M/B Ratio[10/]
		CWW[2/]	DP (%)[3/]	Muscle (%)[4/]	Fat (%)[5/]	Bone (%)	IM (%)[5/]	SC (%)[6/]				
Breeds	DSLT	10.9±1.2	50.5±4.5	62.3±4.3	17.1±2.1	20.5±2.9	6.3±1.1	5.9±1.9	2.5±0.4	8.6±0.7	3.4±0.6	1.4±0.7
	DMalin	9.8±1.2	51.9±5.5	57.0±5.3	22.8±3.4	20.3±1.6	9.4±2.2	9.2±2.9	2.4±0.2	7.8±1.5	2.6±0.5	2.7±0.9
	LS[11/]	NS[12/]	NS	NS	0.05	NS	0.05	0.05	NS	NS	NS	NS
Sexes	Male	11.2±1.7	48.8±3.5	61.0±3.0	16.7±1.9	23.3±2.8	8.0±3.0	6.0±2.0	2.5±0.2	8.4±1.0	3.6±0.6	2.6±0.5
	Female	9.7±1.5	52.0±6.5	56.2±5.1	23.1±2.7	23.0±3.1	7.8±3.4	9.3±2.1	2.3±0.1	8.0±0.4	2.5±0.4	2.4±0.5
	LS	NS	NS	0.05	0.05	NS	NS	NS	NS	NS	0.05	NS
Mean±SE		10.4±1.9	51.2±2.0	60.0±4.3	20.0±2.4	21.7±2.0	7.9±3.8	7.7±1.9	2.4±0.2	8.2±0.5	3.0±0.6	2.3±0.5

1/ from carcass dissection; 2/ CWW = chilled carcass weight; 3/ DP = dressing percentage 4/ total fat (pelt + IM + SC) percentage Based on carcass weight; 5/ IM = intramuscular fat; 6/ SC = subcutaneous fat; 7/ FT = fat thickness at REA; 8/ REA = rib eye area; 9/ M/F = muscle per fat ratio; 10/ M/B = muscle per bone ratio; 11/ LS = level of significant; 12/ = non significant difference

Carcass composition

Carcass traits of the two breeds compared in this study are given in Table 3. The DSLT and DMalin sheep had a similar dressing percentage (DP) (50.5 and 51.9%; P>0.05) while the males tended to be lower DP than the female sheep (49.8 vs. 52.1%; P>0.05). The DP of this present work was similar to those sheep that fattened with sweet corn stover and concentrate diet that studied by Yacob (1994) (51.2 vs. 52.0 %). However, when compare the present results with the report of Yahya et al. (1996) who fattened the DMalin sheep with sago pith meal, it was found that the DP of sheep in this study was about 11.4% lower (51.2 vs. 55.8).

In terms of the muscle percentage (%M), it was observed that the DSLT showed a non-significantly higher %M than the DMalin sheep (62.3 vs. 57.0 %; P>0.05). The males showed a significantly higher %M than the female sheep (61.0 vs. 56.2%; P<0.05). The DMalin had a significantly higher fat percentage (%F) than the DSLT sheep (22.8 vs. 17.1%; P<0.05). The females had a significantly higher %F than the male sheep (23.1 vs. 16.7%; P<0.05). The DMalin had significantly greater intramuscular and subcutaneous fat percentage (%IM and %SC) than the DSLT sheep (6.3 vs. 9.4% and 5.9 vs. 9.2%, respectively). This was in agreement with Vidyadaran et al. (1994) who found that the DMalin had the highest total fat, intramuscular fat and subcutaneous fat percentages followed by St. Croix x Dorsimal and Bali-Bali x Dorsimal sheep.

There were no significant difference in the %IM and %SC of both sexes. However, male tended to have a lower %IM and %SC than the female sheep (P>0.05). The DSTL had a similar %B to the DMalin sheep (20.5 vs. 20.3%, respectively). However, the male showed a higher %B than the female sheep (23.3 and 23.0%; P>0.05).

In terms of muscle : fat (M/F) ratio, the DSLT sheep had a slightly higher M/F ratio than the DMalin sheep (3.4 vs. 2.6; P>0.05). The males showed a significantly higher M/F ratio than the female sheep (3.6 vs. 2.5). There was no significant difference in the M/B ratio between the DSLT and DMalin sheep breeds (1.4 vs. 2.7). The male, however, had a higher M/B ratio compared to the female sheep (3.6 vs. 2.5; P<0.05).

In terms of the fat thickness (FT) at the 12^{th} REA, the DSLT showed a similar FT to the DMalin sheep (2.5 vs. 2.4 mm.; P>0.05). There was no significant difference between males and females (2.5 vs. 2.3 mm.; P>0.05). In terms of the rib eye area (REA), this study indicated that the DSLT had a similar REA to the DMalin sheep (8.6 vs. 7.8 cm^2; P>0.05). Both sexes showed a similar REA with the overall mean was 8.2 cm^2. The smaller REA obtained in this study may be due to a lighter weight at slaughter (Field et al., 1993).

Differences in the carcass composition may due to the breed occur in all species of meat animals (Butterfield (1988); Lohse, 1971 cited by Hilmi, 1975; Berg and Butterfield, 1976). Lighter FT and REA may be related to the high percentage of tropical sheep breeds (Malin and SLT). This was in an agreement of Mukherjee (1994), Ariff et al. (1994) and Davis et al. (1993). For the sex difference on the carcass composition, Fourie et al., (1970) stated that female lamb was fatter and had lesser proportion of muscle and bone than the male lamb. This was also in an agreement with Lodge (1975).

Conclusions

Based on the findings of this study, it may be concluded that the DSLT had a similar DMI to the DMalin sheep (66.0 vs. 64.9 $g/kg^{0.75}$/day). The DSLT grew at a slightly better than the DMalin sheep (108.1 vs. 98.3 g/day; P>0.05). However, the DSLT had a similar dressing percentage to the DMalin sheep (50.5 vs. 51.9%; P>0.05). The DSLT tended to have more muscle (62.3 vs. 57.0%; P>0.05) and a similar bone contents (20.5 vs. 20.3%; P>0.05) to the DMalin sheep. However, in the case of fat deposition in the carcass, the DSLT had a significant lower fat percentage than the DMalin sheep (17.1 vs. 22.8%; P<0.05). There was no significant difference in the FT and REA between the DSLT and DMalin sheep.

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References

Abdul Wahid, S. "Problems associated with importation of temperate sheep into Malaysia". In the Second Symposium on Sheep Production in Malaysia , November 22 - 24, 1994, Faculty of Veterinary Medicine, Serdang : CENTRAS., pp. 109 - 110.

Andrew, R.P. and E.R. Ørskor. 1970. The nutrition of the early weaned lamb. 1. The influence of protein concentration and feeding level on rate of gain in bodyweight. Journal of Agricultural Science 75 : 11 - 18.

AOAC. 1990. Official Method of Analysis of the Association of Official Analytical Chemists. 15th ed. Association of Official Analytical Chemists, Arlington, Virginia.

Ariff, O.M., M. Wan Zahri, A.S. Zainur and R. Moh Salleh. 1994. "Highlights m sheep production research and development". In the Second Symposium on Sheep Production in Malaysia , November 22 - 24, 1994, Faculty of Veterinary Medicine, Serdang : CENTRAS., pp. 67 - 76.

Basery, M., J. B. Liang, A.R. Darus, R. Moh Salleh and K. Musaddin. 1993. "Prime lamb production: Carcass composition of Dorset horn x Malin ram lambs under intensive and semi-intensive systems." In Proceedings of the XVI Malaysian Society of Animal Production Annual Conference , June 8 - 9, 1993. Serdang : MSAP, pp. 138 - 139.

Berg, R.T. and R.M. Bunerfield 1976. New concepts of cattle growth. Sydney University Press, Sidney, Australia. 240 pp.

Bruce, J.M. 1993. "Interactions between the animal and its environment." In Quantitative Aspects of Ruminant Digestion and Metabolism. : CABI, Oxon, UK, pp. 494 - 508.

Butterfield, R.M. 1988. New Concepts of Sheep Growth. Griffin Press Ltd., Netley, South Australia.

Davis, M.P., M.A. Rajion and A.S. Zainur. 1993. Failure of Malin sheep of fatten beyond early adulthood despite optimal nutrition. Journal of Veterinary Malaysia 5 : 37 - 39.

Davis, M.P., M.A. Rajion and A.S. Zainur. 1996. "Prime lamb production without copper poisoning using an economical grass-free palm kernal cake diet." In Proceedings of the Silver Jubilee Malaysian Society of Animal Production Conference , May 28 - 31, 1996, Kuching, Sarawak, Malaysia : MSAP pp. 245 - 246.

Early, R.J., B.W. McBride and R.O. Ball. 1990. Growth and metabolism in somatotropin-treated steers: II. Carcass and noncarcass tissue components and chemical compostion. Journal of Animal Science 68 : 4144.

Field, R.A., G.D. Snowder, M.L. Riley and H.A. Glimp. 1993. Intermuscular fat variability in the large end of ribs from four white-faced breeds of lambs. Sheep Research Journal 9 : 91 - 94.

Fourie, P.D., A.H. Kirton, K.E. Jury. 1970. Growth and development of sheep. II. Effect of breed and sex on the growth and carcass composition of the Southdown and Romney and their cross. New Zealand Journal of Agricultural Research 13 : 753 - 770.

Hilmi, M. 1975. The Effect of Growth Rate on Carcass Composition of Sheep. M. Sc. Dissertation, University of Sydney.

Kearl, L.C. 1982. Nutrient Requirements of Ruminants in Developing Countries. International Feedstuffs Institute, Utah, USA.

Khusahry, M.Y.M., A.R. Gayah, J. Mohamad and M.N. Jariah. 1993. "Productivity of sheep under various production environment." In Proceedings of XVI Malysian Society of Animal Production Annual Conference , June 8 - 9, 1993, Pulau Langkawi, Malaysia, pp. 111 - 112.

Lodge, G.A. 1975. "Improving the nutrient composition of meat-producing animals." In Man, Food and Nutrition. CRC Press, Ohio, USA. pp. 215 - 229.

Mahgoub, O. and G.A. Lodge. 1994. Growth and body composition of Omani local sheep. 1. Liveweight growth and carcass and non-carcass characteristics. Animal Production 58 : 365 - 372.

Mukherjee, T.K. 1994. "Current status and future perspectives of sheep improvement in Malaysia." In the Second Symposium on Sheep Production in Malaysia , November 22 - 24, 1994, Faculty of Veterinary Medicine, Serdang : CENTRAS., pp. 63 - 66.

Owen, J. B. 1976. Sheep Production. Bailliere Tindall, London.

Prescott, J.H.D. 1978. "Growth and development of lambs". In the Management and Diseases of Sheep. Papers presented at a British Council Special Course, Edinburgh, March 5 - 7, 1978, pp. 358 - 376.

Rajion, M.A., A.R. Alimon and M.P. Davis. 1993. Goat and sheep production. In The Animal Industry in Malaysia. Serdang Selangor : Faculty of Veterinary Medicine and Animal Science, Universiti Pertanian Malaysia, pp. 51 - 67.

Rajion, M.A., M.P. Davis, M.K. Vidyadaran, I. Dahlan, A.R. Alimon, M. Hair-Bejo, A. Salim Abdullah, T.I. Azmi and M. Hilmi. 1994. "Advances in sheep production research in Universiti Pertanian Malaysia". In the Second Symposium on Sheep Production in Malaysia , November 22 - 24, 1994, Faculty of Veterinary Medicine, Serdang : CENTRAS., pp. 77 - 84.

SAS 1988. SAS/STAT User's Guide Release 6.03 Edition. SAS Institute Inc., Cary, N.C.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. 2nd McGraw-Hill, New York.

Taylor, R. and T.G. Filed. 1998. An Introduction to Scientific Farm Animal Production. 6th Ed. Prentice Hall, New Jersey, USA.

Tajuddin, I. And D.T. Chong. 1988. "Rubber Research Institute of Malaysia research on sheep integration under rubber". In Proceedings Symposium on Sheep Production in Malaysia , November 15 - 16, 1988, Kuala Lumpur, Malaysia, pp. 73 -82.

Vidyadaran, M.K., M.P. Davis, A.B. Zuki, R. Sidek and R. Sivasoorian. 1994. "Carcass composition of three different crossbred sheep fed fish/corn meal diet". In the Second Symposium on Sheep Production in Malaysia , November 22 - 24, 1994, Faculty of Veterinary Medicine, Serdang : CENTRAS., pp. 117 - 118.

Wan Mohamad, W. E. 1977. "Utilization of ground vegetation for animal rearing". In Proceedings of Rubber Research Institute. Kuala Lumpur, Malaysia. pp. 265 - 281.

Wattanachant, W., I. Dahlan, A. Zulkifli and M.A. Rajion. 1997. Sheep-oil palm integration: Growth performance of Dorset x Malin and Dorset x Siamese Long Tail sheep. Pertanika Journal of Agricultural Science 20 : 169 - 173.

Yacob. 1994. Studies on the utilization and supplementation of sweet corn stover silage and its effect on carcass composition of growing lambs. M. Sc. Thesis, Universiti Pertanian Malaysia.

Yahya, M., M.D. Mohd. Mahyuddin, A.R. Alimon and N. Abdullah. 1996. "Performance and carcass yield of growing sheep fed a sago pith meal based diet". In Proceedings of the Silver Jubilee Malaysian Society of Animal Production Conference , May 28 - 31, 1996, Kuching, Sarawak, Malaysia : MSAP, pp. 295 - 296.