THE EFFECT OF FEED RESTRICTION AND EXERCISE ON GROWTH OF MERINO SHEEP

(Pengaruh Pembatasan Pakan dan Exercise terhadap Pertumbuhan Domba Merino)

Bambang Hartoyo, Satrijo Widi Purbojo, Pambudi Yuwono dan Herry Soeprapto

Fakultas Peternakan UNSOED

ABSTRAK

Penelitian dengan judul "Pengaruh Pembatasan Pakan dan Exercise terhadap Pertumbuhan Domba Merino" dilakukan untuk mempelajari perubahan bobot badan dan komposisi tubuh selama periode pembatasan pakan dan kerja (*exercise*) yang kemudian diikuti oleh pemberian pakan secara adlibitum dan berhenti bekerja. Penelitian ini terdiri dari dua periode. Pada periode pertama, 15 ekor domba Merino kastrasi umur 4 – 5 bulan dibagi menjadi tiga perlakuan, yaitu perlakuan pembatasan pakan dan exercise selama 2,50 jam (perlakuan I), pembatasan pakan tanpa exercise (perlakuan II), serta pemberian pakan secara *ad libitum* tanpa *exercise* (perlakuan III) yang masing-masing perlakuan diulang lima kali. Pada periode kedua, semua domba diberi pakan *ad libitum* tanpa *exercise*. Hasil penelitian menunjukkan bahwa pada akhir periode pertama, domba dalam perlakuan I dan perlakuan II mengalami penurunan bobot badan sebesar 28 dan 27 persen dari bobot badan awal. Selama periode kedua, domba dalam perlakuan I dan perlakuan II tumbuh lebih cepat dari pada domba perlakuan III. Pada akhir periode pertama, domba dalam perlakuan I kehilangan lemak lebih banyak daripada perlakuan II. Selama periode kedua, penimbunan protein domba pada perlakuan I dan II lebih cepat dibanding perlakuan III. Domba dalam perlakuan III mengalami penimbunan lemak lebih banyak daripada perlakuan I dan II. Domba pada perlakuan I dan II selama periode II mempunyai kemampuan makan lebih tinggi per kilogram bobot badan metabolis dibanding domba pada perlakuan III.

Kata kunci : pembatasan pakan, komposisi tubuh, kemampuan makan, pertumbuhan.

INTRODUCTION

Animals normally exhibit compensatory growth following a period of sub-maintenance level of feed intake or following a period of weight loss. The rate of such growth might be increased further if the animals were exercised during the period of food restriction (Sakamoto and Katharrine 1987). For example, hamsters exercised during a period of food restriction lost 20% of live weight and showed significant increases in rates of growth on retirement from exercise (Borer 1987).

Although there appear to be concensus in the literature that a superior rate of liveweight gain is achieved during compensatory growth, the composition of such gain is unresolved. Sheep which were 32 kg or heavier and undergoing compensatory growth had similar body composition to that of the control animals. In other studies (McManus *et al.*1972; Little and Sandland, 1975) however, animals undergoing compensatory growth were observed to lay down more protein than fat. The effect of a combination of exercise and restricted dietary energy intake on the body composition of humans and animals had been investigated in a number of recent studies. For example, Ross and Rissanen (1994) studying obese women subjected to moderate of dietary energy intake and exercise, reported that exercise induced a significant reduction in adipose tissue. In studies using rats

Sakamoto (1987), Sandreto and Tsai (1988) showed that carcasses of exercised rat contained less fat and more lean mass than those of which were restricted in dietary energy intake but not exercised. It is evident from the above that exercise enhances the utilisation of body fat. This has also been observed in ruminant ani- s (Teleni and Hogan 1989). Although the phenomenon of compensatory growth has been widely investigated there is no information on such growth in ruminant animals resulting from the resumption of full feeding after a period of exercise and underfeeding. This experiment is aimed at describing the changes in live weight and body tissues of ruminant animals subjected to a period of exercise plus under feeding followed by a period of full feeding .

RESEARCH METHOD

Experimental design

Fifteen merino wethers (4-5 months of age) were divided into three groups of similar live weight which were then randomly allocated to Treatment groups I, II and III. Treatment I included an under feeding regimen and walking on a treadmill at an incline of 5^{O} at 1.1 m/s for 2.5 h/d , 6 d/week (the energy expenditure is approximately 1.3M). Treatment group II included the under feeding regimen only. Treatment group III was the control group which involved *ad libitum* feeding and no exercise throughout the experiment. Animals in Treatment groups I and II were under fed so that their rates of liveweight loss were closely similar during the allocated seven weeks period (Period I). After the Period I, exercise and under feeding were ended and all the animals were fed *ad libitum* for four weeks (Period II).

Animals and feeding

During the adaptation period, the wethers were kept in individual pens and fed pelleted Lucerne (*Medicago sativa*) *ad libitum*. Following this period the animals were fed according to the feeding regime outlined above The amounts of feed given to the animals in treatment groups I and II were adjusted progressively during Period I to ensure that animals in the two groups lost live weight at similar rate. The animals in treatment groups I and II were fed once a day at 08,00. The animals in treatment group III were offered feed at the same time of the day but at a level equivalent to 120 percent of their intake the previous day. Feed residues from the previous 24 h were removed before the animals were fed.

Measurement, sampling and sample preparation

(a) Weighing

All animals were weighed within the same time period (60 mins) on the same day each week. Weighing was conducted before feeding.

(b) Body composition

The body composition of each animal was estimated using TOH technique. Estimations were carried out immediately prior to Period I, at the end of period I and at the end of Period II.

(c) Feed intake and digestibility

The determinations of feed intake and digestibility were carried out over a 7-day period after at least a 7-day adaptation

period of the animals to experimental conditions. The amounts of feed offered and feed residues were recorded daily at week two of Period I and at week three of Period II

Faeces collected over 24 h before feeding at 17,00 each day. The amounts of feed and faeces was measured and treated as described in Section 3.2.3

Laboratory analyses

Dry matter and OM of feed offered, feed residues and faeces were determined. The N contents of feed offered, feed residues, faeces were also analysed.

Statistical analyses

Data on feed intake, digestibility were analysed using one way analysis of variance using the statistical package SPSS (SPSS Inc. Releas 6.0). To compare means of treatment groups were assessed using the least significant different.

RESULTS

Liveweight changes

The mean live changes of all animals during Periods I and II are presented in Figure 1

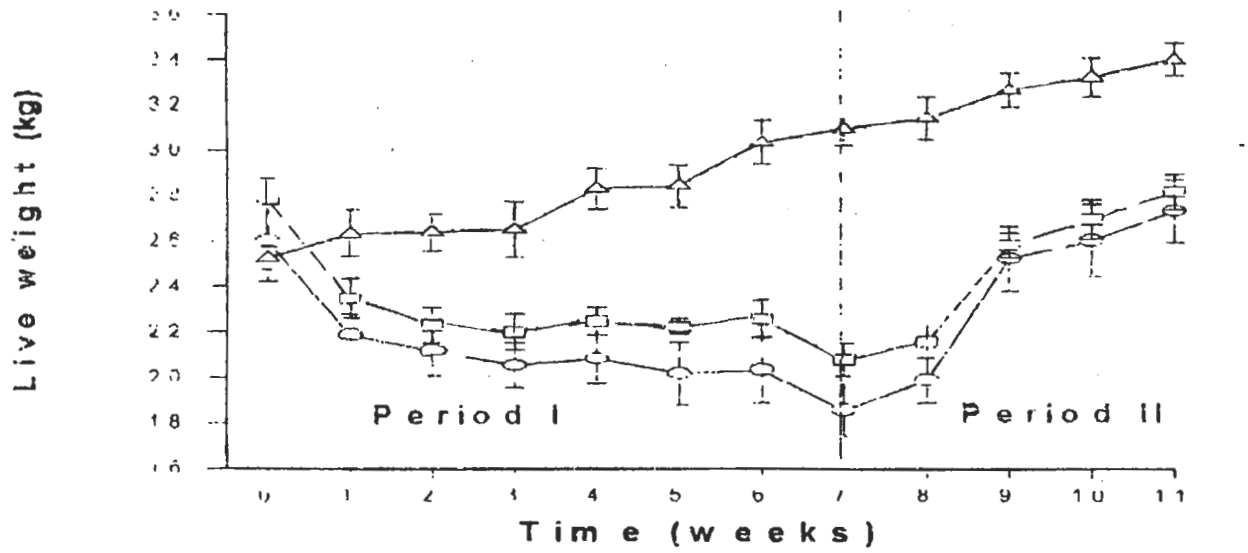

Figure 1 Liveweight changes in sheep in Treatment group I (○ ,under fed and exercised), II (□ ,under fed and not exercised), III (△ ,fed *ad libitum* and not exercised). At the end of Period I, the animal in treatment groups I and II lost 28% ± 1 and 27% ± 1 (mean ± SE) of their starting liveweight respectively, while the animals in treatment group III gained 20% ± 3 (mean ± SE) of their starting live weight. The rate of live weight loss was not different between animals in Treatment groups I and II see Figure 4A.2). During Period II, animals in Treatment groups I and II had higher rates of gain (see Figure 4A.2)

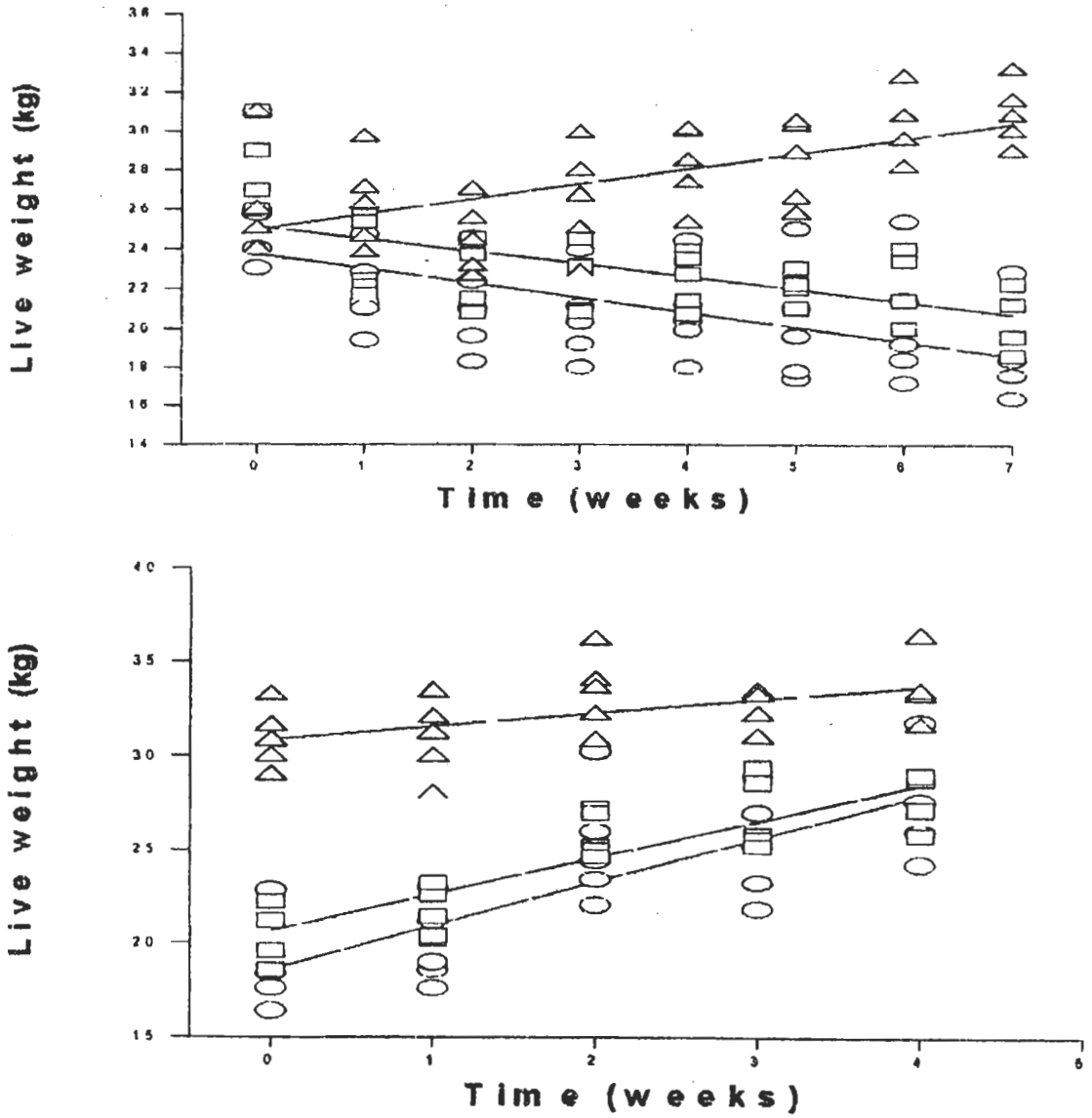

Figure 2 Regressions of live weight on time of animals in treatment groups I (○ ,under fed and exercised), II (□ , under fed and not exercised), III (△, fed *ad libitum* and not exercised) during Periods I (i) and II (ii). The regression equation during Period I for the animals in Treatment group I, II and III were $y_1 = 24.5 - 0.74$ X with r = - 0.84, $y_2 = 25.8 - 0.64$ X with r = - 0.74 and $y_3 = 24.2 + 0.81$X with r= 0.96, respectively. The regressions equation during Period II for the animals in Treatment groups I, II and III were $y_1 = 16.3 + 2.34$ X with r = 0.95, y2 = 24.6 + 2.02 X with r = 0.96, y3 = 29.8 + 0.84 X with r 0.97, respectively.

Feed utilisation

The intake, digestibility of feeds and estimated energy expenditure and efficiency of feed utilisation in the animals in Treatment groups I, II and III during Period I and II are presented in Table 1. The mean intake of DM, OM, N, ME and water was not different between the animals in Treatment groups I and II during the periods I and II. The mean intake of DM, OM, N ME and water of the animals in Treatment group I and II was higher than that of the animals in Treatment group III.

Table 1 The mean live weight, the intake of feed dry matter (DM), organic matter (OM), digestible organic matter (DOM), nitrogen (N), metabolisable energy (ME), and water in animals in Treatment groups I (under fed and exercised), II (under fed and not exercised), III (fed *ad libitum* and not exercised)

		Period I				Period II			
		Treatment groups				Treatment groups			
		I	II	III		I	II	III	
live weight (kg)		20.8^{a}	22.4^{a}	28.42^{b}	<0.01	25.2^{a}	26.9^{a}	33.2^{b}	<0.01
	sd	1.1	0.7	1.0		1.3	0.9	0.9	
Intake (g/kg $LW^{0.75}$)									
DM		30.3^{a}	30.9^{a}	87.2^{b}	<0.01	119.2^{a}	115.2^{a}	101.5^{b}	<0.01
	sd	2.4	2.3	6.3		2.1	2.7	4.3	
OM		27.5^{a}	26.2^{a}	80.2^{b}	<0.01	106.6^{a}	103.0^{a}	89.8^{b}	<0.01
	sd	2.2	1.5	9.8		1.9	2.4	3.7	
DOM		16.8^{a}	16.3^{a}	47.8^{b}	<0.01	65.0^{a}	62.3^{a}	52.0^{b}	<0.01
	sd	1.5	1.9	4.0		1.4	1.6	2.8	
N		1.0^{a}	0.9^{a}	2.5^{b}	<0.01	3.9^{a}	3.7^{a}	3.3^{b}	<0.01
	sd	0.1	0.02	0.2		0.2	0.1	0.2	
ME (MJ/kg $LW^{0.75}$)[1]		0.2^{a}	0.1^{a}	0.7^{b}	<0.01	1.6^{a}	1.3^{a}	0.7^{b}	<0.01
	sd	0.02	0.01	0.03		0.2	0.1	0.04	
Water		135.1	227.1	288.3	>0.05	442.4^{ab}	460.0^{a}	377.3^{b}	<0.05
	sd	10.48	54.1	76.1		11.9	34.9	19.2	
N : DOM		0.06	0.06	0.05		0.06	0.06	0.06	>0.05

Means with the same superscript in the same row do not differ significantly

[1]. ME (MJ/kg $LW^{0.75}$) = 0.15 DOM (%DM) x DM intake / $LW^{0.75}$

DISCUSSION

Liveweight changes

During Period I, animals in Treatment groups I and II lost weight due to the animals had energy deficit, while animals in Treatment group III gained weight. The liveweight loss for animals in Treatment group I and II was 28 and 27% of their initial live weight respectively. Based on fasting weight, however, animals in Treatment groups I and II lost 18 and 17% respectively. Such amount of live weight loss has been reported in the field.

Little and Sandland (1975), based on the regression equation of live weight on time it would take 12 weeks for animals undergoing compensatory growth to catch up live weight of the animal undergoing normal growth.

Feed utilisation

During Period I, underfed animals (Treatment groups I and II) had similar digestibility of DM, OM and N. This result is contrary to the clasical points of view. They failed to establish the effect of variuos level of feed intake on the digestion. An increase in digestibility when intake decreases can be due to turnover rate of both particles and liquid in the digestive tract and changes in microbial population (Fell and Weekes, 1975).

The N:DOM ratio of the diet range from 0.05-0.06 were higher than the value (0.04) considered to be the optimum value for microbial growth. This might explain why underfed animals did not have a higher digestibility of feed since the extent of ruminal digestion mainly depends on microbial activity and the rate of particle outflow. The decrease in the micro organism population in the rumen can be related to decrease out flow rate. This can be a consequence of a lower energy availibility.

During Period II, animals in Treatment groups I and II undergoing compensatory growth had a higher intake of feed DM, OM and N per unit of kg metabolic live weight than animals in Treatment group III. The feed DMI for animal in Treatment group I, II and III were 5.3, 5 and 4% of live weight respectively). The increase in feed intake, however, was not accompanied by higher digestibility. This might be due to the rate of flow of digesta was faster in animals undergoing compensatory growth which could be the result of the digestive tract of animals in Treatment groups I and II has not recover their initial size.

During Period II animals in Treatment groups I and II utilised dietary protein more efficiently than animals in Treatment group III This probably due to protein was deposited at a faster rate in animals in Treatment group I. Similar finding was reported by Burton *et al.* (1974), Little and Sandland (1975). The faster rate of protein deposition at the beginning of resumption of feeding might be the result of rapid recovery of the liver and gastrointestinal tract.

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