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The Effects of Docking on Growth Traits, Carcass Characteristics and Blood Biochemical Parameters of Sanjabi Fat-tailed Lambs

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ABSTRACT : The effects of docking on growth traits, fattening performance, carcass characteristics and blood biochemical parameters were investigated using 24 fat-tailed Sanjabi single-born male lambs raised from a large commercial sheep herd. The lambs were randomly divided into two groups. One group (n = 12) were docked at two days of age with rubber-rings using an elastrator. The second group (n = 12) were left intact. After weaning (90 days), all lambs were moved to rustic rangelands for 40 days. Then all the lambs were fed concentrates *ad libitum* for 60 days during the fattening period. Growth traits, body weight and average daily gain (kg) were recorded at the end of the weaning and fattening periods. Blood biochemical parameters including urea, total protein, glucose, triglycerides, cholesterol, low-density lipoproteins (LDL) and high-density lipoproteins (HDL) were measured during the fattening period. Finally, at the end of the fattening period, eight lambs (4 intact and 4 docked lambs) were slaughtered in order to determine carcass characteristics. Fat-tail docking had no effect ($p>0.05$) on lamb growth from birth to weaning. Body weight and average daily gain of docked lambs were significantly higher ($p<0.05$) than for intact lambs at the end of the fattening period. There was no difference in carcass measurements between the two groups, except for chest depth and leg weight which were higher ($p<0.05$) in docked lambs. During the fattening period, cholesterol and LDL of docked lambs were less than in intact lambs ($p<0.05$). The current results indicated that docking with rubber rings causes an improvement in growth traits during the fattening period and leads to desirable carcass characteristics compared to intact lambs; interestingly, this procedure had a significant effect on the lowering of blood cholesterol and LDL of docked lambs. (**Key Words :** Blood Parameters, Carcass Characteristics, Fattening, Growth Traits, Lamb Docking)

INTRODUCTION

Fat-tail removal (docking) of lambs is an important management practice in commercial sheep production (Snyman et al., 2002; Cloete et al., 2004). The results of many investigations have shown that docking decreases metabolizable energy (ME) requirement due to lower fat deposition, has a positive impact on reproductive performance and produces more uniform and blocky lambs in appearance (Wohlt et al., 1982; Shelton 1990; Snayman, 2002). Lambs are cleaner and less prone to infection and external parasites (Wohlt et al., 1982). Therefore, it is beneficial in improving daily live weight gain, fattening trait and carcass characteristics for consumers (Bingoal et al., 2006). The fat deposited in the body or tail is laid down at a much higher cost in terms of feed energy than lean meat. Dressed lamb carcasses have a neater appearance and thus receive higher market prices (Gokdal et al., 2003). Also, consumers in many instances show an increasing preference for lean meat (Emam Jom-e Kashan et al., 2005).

Approximately 64% of the sheep population in Iran consists of fat-tailed breeds. The fat tailed sheep are characterized by adaptation to harsh environments i.e. extreme temperatures and poor feeding conditions (Emam Jom-e Kashan et al., 2005). The Sanjabi is a dual-purpose (mutton and wool) native breed which has a high growth rate with good meat quality. Since this breed is classified as a long fat-tail family, propagation of docking may lead to good economical benefits for the sheep husbandry in this region. Changes in consumer preferences favoring leaner meat, the growing awareness of the danger of high fat diets, as well as the availability of alternative cheaper and healthier fat sources have resulted in a reduced demand for sheep with a fat-tail. The objective of this study was to evaluate the effects of docking on growth traits, fattening performance, carcass characteristics and some biochemical parameters of fat-tailed Sanjabi male lambs. This

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Table 1. Ingredients and nutrient composition of diet

Components	%
Alfalfa hay	27
Barley grain	20
Wheat straw	17
Wheat barn	6
Corn grain	7
Beet pulp	11.6
Limestone	0.5
Salt	0.9
Premix	0.6
Nutrient composition %	
DM	90.3
ME (Mcal/kg)	2.45
CP	15.5
NDF	25
Ca	0.75
P	0.32

investigation is the first report on the effect of docking on economic traits and blood biochemical parameters of Sanjabi sheep.

MATERIALS AND METHODS

This experiment was conducted in a large commercial Sanjabi herd located at Kermanshah province in the west of Iran. A total of 24 fat-tail Sanjabi single-born male lambs were used in this study. The lambs were born in June 2007 and immediately were randomly divided into two groups. One group (n = 12) were docked at two days of age with rubber-rings using an elastrator. The second group (n = 12) were left intact. The lambs were allowed to stay with their dams for 3 months until weaning. All lambs were moved to rustic rangelands after the weaning period for 40 days. Lamb weights were recorded weekly and normal inoculation, drenching and tick control programs were also followed during the experiment. Then, all lambs were placed on a fattening diet for 60 days. The lambs were housed in two groups and fed with concentrate and forage (Table 1) for the duration of the fattening period. At the beginning and end of the fattening period, live weights of all lambs were recorded. The following growth traits were recorded: initial weight, final weight, total weight gain and average daily gain (ADG) in the pre-weaning and fattening periods.

Carcass traits

Four docked lambs and four intact ones were slaughtered immediately after the fattening period. Lambs were killed by exsanguination using conventional humane procedures. The body was divided into individual components which were then weighed separately as internal organs (liver, heart, lungs and trachea, kidneys, testes and spleen), head (disarticulated at the occipito-atlantoid articulation), feet (disarticulated at the tarso-metatarsal and the carpo-metacarpal articulations), and carcass. Visceral fat (separable fat in the body cavity) was separated at the time of harvest and weighed. The kidney fat was also physically separated from both sides and weighed. All carcasses were weighed hot (approximately 1 h. after harvest) and then chilled (-4°C) for approximately 24 h. After chilling, the carcasses were weighed again and then longitudinally halved with a band saw. Records of carcass components included carcass measurements (cm) (Chest dept, Leg dept, Chest width, shoulder width, rump width, leg width, leg length, carcass length), Carcass weight (kg) and dressing percentage (%) i.e.; Slaughter weight, cold carcass weight (CCW), offal items (head, 4 feet, skin, heart, lung, liver, testes, kidney, spleen, kidney and pelvic fat, internal fat and tail weights). The cold carcass was split along the backbone according to the procedure of Colomer-Rocher et al. (1987). The left half of the carcass was separated into five anatomically defined cuts (Fernands et al., 2008).

Chemical analysis

The whole soft tissue (fat and lean meat) of the left side of the carcass was ground and passed twice through a plate with a 4 mm orifice. After fine grinding of the small, frozen pieces and thorough homogenization, representative samples were taken for determination of moisture, dry matter (DM), crude protein, ash and lipid contents using AOAC (1990) procedures.

Blood parameters

Blood samples from all lambs were collected at four and one weeks before slaughter from the jugular vein (5 ml) into sterile vacuum tubes Venoject® (BD Vacutainer system, Plymouth, UK). Following standing at room temperature for 20 min., blood samples were centrifuged at 3,000 rpm for 10 min. and the serum samples stored at -25°C until analyzed. Serum urea, uric acid, total protein, triglyceride, LDL, HDL, cholesterol and blood glucose concentrations were determined with commercial kits (Chimi Daro, Coulter Company, Iran). These components were determined via Utoanalyser Hitachi.

Data analysis

The mathematical model for the analysis of growth traits, slaughter and carcass characteristics, proportional yields, blood parameters, and proximate chemical composition included the fixed effects due to treatment (intact and docked lambs) and residual error (SAS 2002, Windows, 9.0). Student's unpaired *t*-test was used to determine significant differences between mean values according to the model:

$$Y_{ij} = \mu+Ti+e_{ij}$$

Table 2. Mean ($\bar{X}$ ±SE) growth traits of intact and docked lambs

Trait (kg)	Groups		
	Intact lambs	Docked lambs	Sig.
Weaning period			
Initial weight	4.225±0.209	4.650±0.272	0.252
Final weight	14.620±1.063	13.670± 0.618	0.450
ADG	0.130±0.012	0.117±0.007	0.376
Total weight gain at weaning	10.040±0.958	9.020±0.587	0.376
Fattening period			
Initial weight	25.395±1.942	27.450±1.478	0.411
Final weight	31.750±1.703	34.650±1.612	0.045*
ADG	0.235.37±33.14	0.266.66±33.90	0.049*
Total weight gain at fattening	6.355±0.895	7.200±0.915	0.044*

* Within rows differences were statistically significant at p<0.05.

Where y_{ij} = dependent variable; μ = overall mean; Ti = fixed effect of the i^{th} treatment; and e_{ij} = random residual.

RESULT AND DISCUSSION

Growth traits

Body weights of intact and docked lambs during the experiment are presented in Table 2. There were no significant differences in growth traits of docked and intact lambs during the weaning period. These results are in accordance with those reported by Joubert and Ueckermann (1971) who found no difference in weight gain and live weight from tail docking to slaughter weight at 100 days of age in Namaqua Afrikaner, Pedi and Blackhead Persian ewes. Similarly, for Karakul and Karakul×Rambouillet lambs Shelton et al. (1991), Al Jasssim et al. (2002) and Mari and Behgat (2003) reported that tail docking had no effect (p>0.05) on lamb growth from birth to weaning.

Based on the data from Table 2, the docked lambs had significantly higher weight, ADG and total weight gain during the fattening period than intact lambs (p<0.05). Total weight gains during the fattening period were 6.355±0.895 and 7.200±0.915 kg for the intact and docked lambs with corresponding estimates for daily gain of 0.235±33 and 0.266±33 kg, respectively (p<0.05). These results are in accordance with those reported by Bicer et al. (1992), Al Jassim et al. (2002), Gökdal et al. (2003), Bingöl et al. (2006), and Moharrery (2007) who found significant difference in final weight between docked and intact lambs and that the docking operation resulted in higher ADG and total weight gain in the fattening period than in intact animals. In contrast, El Karim (1980) and Bingoal et al. (2005) reported that growth traits in the fattening period (average daily gain, final body weight) were not significantly different between intact and docked lambs. Also, they found no significant differences between docked (0.171.428±11.203 kg) and intact lambs (0.156.503±14.067 kg) in ADG and total weight gain over the total period from birth to the end of fattening.

Slaughter and, carcass characteristics

The slaughter and carcass characteristics for intact and docked lambs are summarized in Table 3, and proximate analysis on meat cuts of the left half of the carcass (hind leg, loin, ribs, fore leg and neck) are summarized in Table 4. Comparison between the two groups of lambs for carcass measurement (cm) showed that fat-tail docking had an effect on chest depth (p<0.01) and leg width (p<0.05), but had no effect (p>0.05) on the other carcass parameters. These results are in good agreement with reports by Gökdal et al. (2003) for Karakas lambs and Bingoal et al. (2005) for fat-tailed Norduz sheep.

The results in Table 3 show slaughter weight, CCW and dressing percentage of control lambs were lower than in docked lambs, although the difference were not significant (p>0.05). Docking lambs resulted in 14.30%, 15.80% and 5.26% higher untailed warm and cold carcass weight, and untailed dressing percentage (p<0.05), respectively, compared with the control lambs.

These findings are consistent with those of Shelton et al. (1991), Gökdal et al. (2003), Mari and Bahgat (2003) and Bingol et al. (2005) who found that the carcass weight and dressing percentage of docked were higher than for intact lambs. Similar results for slaughter weight, warm and cold carcass weights were reported by El Karim (1980) for Dubasi sheep.

In the present study, docked lambs had greater weights (kg) for offal items (head, heart, lungs and liver, testes, and spleen) (p<0.05), and docking had no effect (p>0.05) on the weights of the four feet, pelt, kidney fat and internal fat of the ram lambs. Weight of the fat-tail and fat around the tail differed between intact and docked animals (1.760±0.196 kg vs. 0.495±0.033 kg) (p<0.01). Al Jassim et al. (2002), Mari and Behgat (2003), Gökdal et al. (2003) and Bingol et al. (2005) also reported a lower offal item weight (kg) for intact than docked lambs, although there was little difference between their results and ours. In all reports,

Table 3. Mean ($\bar{X}$ ±SE) carcass characteristics and proportional yield of intact and docked lambs

Traits	Intact	Docked	Sig.
Carcass measurement (cm)			
Chest depth	26.00±0.500	29.667±0.333	0.004**
Chest width	17.333±1.014	20.000±0.577	0.084
Leg depth	34.000±1.000	34.333±0.882	0.815
Leg length	37.667±1.333	37.333±0.333	0.820
Leg width	13.167±0.928	17.167±0.601	0.022*
Shoulder width	17.333±1.093	17.833±1.424	0.749
Rump width	16.500±1.258	19.000±0.288	0.125
Carcass length	57.000±1.527	57.666±1.202	0.749
Carcass weight (kg)			
Slighter weight	28.830±0.182	30.150±0.683	0.135
WCW with fat-tail	13.373±0.434	14.046±0.342	0.291
Untailed WCW	11.613±0.333	13.552±0.316	0.013*
Cold carcass weight	13.126±0.478	13.386±0.340	0.681
Untailed CCW	11.688±0.667	13.882±0.365	0.045*
Dressing percentage (%)			
Dressing percentage	46.378±1.338	46.623±1.401	0.905
Untailed dressing percentage	39.717±1.257	44.983±1.363	0.047*
Offal items weight (kg)			
Head	1.668±0.033	1.888±0.025	0.006**
4 feet	0.792±0.037	0.885±0.018	0.087
Pelt	2.845±0.265	2.253±0.107	0.108
Heart, lungs and liver	0.948±0.017	1.123±0.421	0.018*
Testes	0.070±0.013	0.165±0.028	0.039*
Kidney	0.335±0.257	0.086±0.003	0.390
Spleen	0.107±0.006	0.167±0.007	0.003**
Kidney fat	0.035±0.010	0.567±0.011	0.231
Internal fat	0.0816±0.036	0.173±0.024	0.105
Tail	1.760±0.196	0.495±0.033	0.003**
Wholesale cuts of left half carcass weight (kg)			
Hind leg	2.080±0.083	2.368±0.056	0.046*
Loin	0.717±0.036	0.817±0.024	0.083
Ribs	1.255±0.055	1.736±0.071	0.006**
Fore leg	1.186±0.076	1.298±0.031	0.245
Neck	0.560±0.046	0.676±0.037	0.122
Proportion of wholesale cuts and organs (%)			
Heart, lungs and liver	0.711±0.003	0.079±0.001	0.059*
Testes	0.005±0.001	0.0117±0.002	0.030*
Kidney	0.026±0.021	0.006±0.000	0.386
Spleen	0.007±0.000	0.012±0005	0.002**
Kidney fat	0.003±0.000	0.004±0.007	0.242
Internal fat	0.006±0.003	0.012±0.002	0.108
Tail	0.131±0.012	0.035±0.002	0.001**
Hind leg	0.155±0.004	0.168±0.004	0.084
Loin	0.053±0.003	0.058±0.003	0.369
Ribs	0.094±0.007	0.123±0.003	0.018*
Fore leg	0.088±0.002	0.093±0.004	0.489
Neck	0.042±0.003	0.048±0.002	0.104

**, * Within rows differences were statistically significant at p<0.01 and p<0.05 respectively.

docked fat-tail weight was higher than intact lambs (p<0.01).

The wholesale cuts of the left half carcass (5 cuts) are presented in Table 3. The hind leg weight (p<0.05) and ribs weight (p<0.01) were heavier for docked lambs. Similarly, other cuts (loin, fore leg and neck weight) were higher in docked than intact lambs but there were no significant differences between the two groups (p>0.05). It has been

Table 4. Mean ($\bar{x}$ ±SE) five wholesale cuts of carcass of intact and docked lambs

Traits (%)	Lambs groups		
	Intact	Docked	Sig.
Hind leg			
DM	26.402±1.182	24.172±1.899	0.375
Crude protein	41.596±2.425	42.967±3.861	0.899
Lipids (EE)	11.267±1.256	14.114±2.321	0.322
Ash	2.161±0.824	2.965±0.261	0.405
Lion			
DM	31.855±2.311	23.065±1.139	0.027*
Crude protein	43.619±4.277	44.830±6.754	0.960
Lipids (EE)	14.610±2.356	17.615±1.526	0.138
Ash	3.184±1.277	3.010±1.297	0.928
Ribs			
DM	27.147±2.994	26.052±1.854	0.771
Crude protein	40.849±5.794	45.935±4.574	0.735
Lipids (EE)	15.010±2.652	19.214±2.315	0.031*
Ash	3.761±1.478	2.477±1.609	0.520
Fore leg			
DM	29.047±4.289	26.308±2.756	0.620
Crude protein	42.004±6.850	45.753±1.977	0.627
Lipids (EE)	12.511±2.514	14.715±1.812	0.888
Ash	1.940±0.661	4.432±1.658	0.235
Neck			
D.M	29.777±3.702	24.538±2.003	0.281
Crude protein	51.543±4.319	55.534±3.307	0.765
Lipids (EE)	12.411±1.258	13.652±1.648	0.345
Ash	1.459±0.541	4.219±1.556	0.350

* Within rows differences were statistically significant at p<0.05.

reported that docking of fat-tail sheep increased the weights of valuable wholesale cuts in the carcass of these breeds (Gürsoy et al., 1992; Bingöl et al., 2002; Gökdal et al., 2003) and Bingol et al. (2005).

Proportions of wholesale cuts and organs of the carcass are summarized in Table 3. There were significant differences in proportional yields of heart, lung and liver, testes, ribs ($p<0.05$), spleen and fat-tail percent ($p<0.01$) between the docked and intact lambs. An increase in fat around internal organs in response to docking and a decrease in the fat-tail portion have been reported by Bıyıkoğlu et al. (1977), Cengiz and Arık (1994), Bingöl et al. (2002 and 2005) and Gökdal et al. (2003). The results of the present study are in accordance with the report by Cengiz and Arık (1994) that docking reduced significantly the amount of total fat in the body lambs. From the results of Moharrery (2007), it is evident that docking of Iranian Badghisian lambs after birth improved amounts of high price carcass fragments in the whole body.

Carcass chemical composition

The chemical composition, including DM, crude protein, lipid and ash, of the five carcass cuts are presented in Table 4 for the two groups. The fat-tail docking had no effect on chemical composition of the five cuts ($p>0.05$). The DM of all five cuts was higher for intact than docked lambs ($p>0.05$). Quantities of crude protein in the five parts of the left half of the carcass were higher for docked than intact lambs ($p>0.05$). The lipid component of these five parts was higher for docked than intact lambs ($p>0.05$), but lipid content of the ribs part was significantly different ($p<0.05$). In accordance with the results of Snyman et al. (2002), in this investigation ash content of the carcass of docked lambs was higher than intact lambs ($p>0.05$).

It has been reported that docking of fat-tail sheep had no significant effect on chemical composition of the carcass (Bingol et al., 2005; Moharrery, 2007). Moharrery (2007)

Table 5. Mean ($\bar{x}$ ±SE) blood parameters of intact and docked Sanjabi lambs during fattening period

Blood parameters (mg/dl)	Lamb groups		
	Intact	Docked	Sig.
At the start of fattening			
Urea	29.600±1.368	26.700±1.044	0.109
Total protein	7.020±0.12	6.990±0.105	0.853
Glucose	70.800±2.768	72.400±2.642	0.681
Triglycerides	7.700±1.738	5.100±1.479	0.270
Cholesterol	69.300±3.858	58.100±3.497	0.045*
LDL	25.00±1.896	19.300±1.711	0.039*
HDL	39.500±1.892	35.500±1.586	0.123
At the end of fattening			
Urea	46.300±1.819	45.600±1.400	0.764
Total protein	6.840±0.151	6.850±0.121	0.959
Glucose	72.800±2.375	73.000±4.784	0.931
Triglycerides	11.400±1.904	8.400±3.041	0.141
Cholesterol	69.300±3.858	58.100±3.497	0.045*
LDL	15.970±1.253	13.810±1.293	0.246
HDL	31.400±0.792	28.400±1.904	0.163

* Within rows differences were statistically significant at p<0.05.

showed that docked lambs had higher fat and lower protein and moisture percentage in meat ($p<0.05$), and a decreased ($p<0.05$) carcass fat content.

Blood parameters

The blood parameters of the two groups during the fattening period are presented in Table 5. Urea, total protein, triglycerides, and HDL were higher ($p>0.05$) in the intact group than in the docked group at the start of fattening. Interestingly, decrease of the two parameters cholesterol and LDL was an important event in the docked group ($p<0.05$). There was a significant difference ($p<0.05$) in cholesterol level between intact and docked lambs at the end of fattening. No report has been published in the literature on the effect of docking on blood parameters.

IMPLICATIONS

From the results of this study, docking of Sanjabi lambs at the second day after birth using rubber rings had no effect on early growth traits during the weaning period compared with intact lambs. During the fattening period, docking increased growth rate, live body weight, carcass weight and edible carcass offal (liver, lungs, heart and kidney). In conclusion, docking of fat-tailed Sanjabi sheep improves their fattening performance, desirable carcass characteristics and marketing. This practical management is of benefit to both herd managers and consumers.

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