EFFECT OF IMPLANTING ZERANOL ON GROWTH AND CARCASS CHARACTERISTICS OF AWASSI LAMBS AND GOAT KIDS RAISED UNDER COMMERCIAL CONDITION

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ABSTRACT

The current experiment was designed to investigate the effect of zeranol implantation on lambs and goats' kids raised under commercial conditions. Ten male Awassi lambs (AL) (4-5 months old) with an average body weight of 33.7 ± 0.5 kg and 10 male black goat kids (GK) (3-4 months old) with an average body weight of 18.8 ± 0.7 kg were used in the experiment. The experiment was conducted in Berebuhar village close to Duhok city in May the 15th, 2019The animals from each group were randomly divided into two subgroups, the first group was the control group and the other group was implanted with 24 mg zeranol. The animals were grown for 43 days and then slaughtered. Growth rate, average daily gain and carcass characteristics were measured. Data were analysed as factorial 2 × 2. The results showed that implantation both animal groups with zeranol significantly reduced testicular weight by approximately 55 % and 71 % for goat kids and Awassi lambs respectively. Moreover, the results showed that zeranol implantation found to reduce total body fat from 892 to 816g in goat kids and from 3395 to 2856 g in Awassi lambs. It can be concluded that zeranol implantation has an effect on total body fat and fat tissue distribution.

Keywords: Feed efficiency, growth promoter, zeranol, distribution of body fat tissues.

مجلة العلوم الزراعية العراقية -2020: 51 (5):1321-1328 كاك وآخرون

تاثير حقن الزيرانول في النمو وصفاة الذبيحة لحملان العواسيمة و جدايا الماعز المحلي المبراة تحت الضروف التجارية

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المستخلص

اجريت هذه التجربة لدراسة تاثير غرس الزيرانول لحملان العواسية و جديان الماعز الاسود المحلي المبراة تحت الضروف التجارية في احدى القرى القريبة من مدينة دهوك في الخامس عشر من ايار 2019. عشرة حملان ذكور عواسية بمعر 4-5 اشهر ووزن 33.7 كغم و عشرة جدايا ذكور الماعز الاسود المحلي بعمر 3-4 اشهر و وزن 18.8 كغم استعملت لهذه التجربة. قسمت كل مجموعة من الحيوانات عشوائيا الى مجموعتين بحيث المجموعة الاولي كمجموعة السيطرة و المجموعة الثانية غرست بهرمون الزيرانول 24 مل لكل حيوان. ربيت هذه الحيوان لفترة 43 يوم وذبحت و تم دراسة: نمو الحيوانات والزيادة الوزنية اليومية و صفات الذبيحة. اضهرت النتائج ان حقن حملان العواسية بالزيرانول قد ققللت وزن الخصية بحوالي 55 % و 70 % لكل من الماعز الاسود و حملان العواسي على التوالي. كذلك اضهرت النتائج ان غرس الزيرانول ادت الى تقليل الانسجة الدهنية الكلية للجسم من 892 الى 816 غم في جدايا الماعز الاسود و 3395 الى 2856 غم في الحملان العواسية. و نستنتج ان للزيرانول تاثير على تقليل الانسجة الدهنية و توزيعها في الجسم.

الكلمات المفتاحية: الكفائة الغذائية,معامل النمو, زيرانول و توزيع الانسجة الدهنية.

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INTRODUCTION

The price of animal feed ingredients has been increasing linearly since the mid of the last century (30). DEFRA (9) reported that the price of soybean meal, rapeseed meal, maize gluten, brewers' grain, and silage have been increased by approximately 140, 80, 75, 100 and 50% respectively, from 2005 until 2014, and this has encouraged ruminant farmers to maximize feed efficiency in order to reduce animal production cost. Improving feed efficiency is considered as one of the most important factors that increase farmer's income (4). Many feed additives, growth promoters and/or drugs such as herbs, plant secondary compounds and hormones have been used to increase animal feed efficiency, hence, enhancing animal performance and increasing their production (30 and 1). A report published by The Animal Health Institute of America (23) indicated that without using these treatments (feed additives and/or growth promoters) in farm animals, the price of animal products (particularly meat) would rise. Also, to control the prices the USA might need an addition of approximately 500 million poultry, 25 million cattle and 12 million pigs (23). Improving the quality of meat more specifically producing low-fat meat according to consumers' desire is still one of the main goals that meat producers tried to achieve (2). Many studies have been carried out since the mid of the last century for using growth promoters in the animal industry to regulate metabolism and nutrients utilization (1). Since the first cattle implantation with anabolic steroids in the 1950s, it has been shown that it improves animal growth rate, feed efficiency and meat quality under both experimental and commercial conditions (11). Additionally, other studies found that cattle implantation with anabolic steroids led to an increase in carcass weight (15), rib-eye muscle area (18) and average daily gains (21) compared to untreated cattle. Bouffault and Willermart (7) highlighted that among these growth promoters, zeranol behaved as an estrogen-like activity when farm animals were implanted with it. Zeranol is known as an anabolic agent that widely used to improve growing-finishing ruminant animals. It was discovered in maize grains infected with mould Giberella zeae (27). Serval studies found that implanting ruminant animals with zeranol improved feed efficiency and average daily gain (32, 17, 24 and 26). Moreover, Hufstedler et al. (16) indicated that implanting ruminant animals with zeranol enhanced animal performance and exhibit the capacity for producing leaner and more acceptable carcasses. Alkass and Kak (4) found a slight response when they implanted two breeds of local Iraqi lambs with zeranol (12 mg/animal). Most of the studies covered implanting zeranol to ruminant animals under experimental conditions. However, the implantation of zeranol to lambs or goat kids raised under commercial conditions is not previously investigated. Therefore, the objective of this experiment was to investigate the effect of implanting high levels of zeranol (24 mg/animal) to weaned Awassi lambs (AL) or goat kids (GK) raised under commercial condition.

MATERIALS AND METHODS

Animals and experimental design

Ten Awassi crossbred local ram lambs (4-5 months old) with an average body weight of 33.7 ± 0.5 kg and 10 local black buck goat kids (3-4 months old) with an average body weight of 18.8 ± 0.7 kg were used in the present study. The animals were provided from one commercial farm only in order to grantee that they rose under the same condition, although there was a variation in the age and weight between both animal groups (species). The animals from each of the two groups were randomly divided into two subgroups, where one of them was a control and the second one was the experimental group which implanted with 24 mg zeranol (12 mg in each ear). Therefore, the experimental treatments were untreated Awassi lambs (SC), implanted Awassi lambs with zeranol (SZ), untreated goat kids (GC) and implanted goat kid with zeranol (GZ). The experiment started on the 15th of May 2019 and continued for 43 days. The animals were raised at a commercial farm in Barebuhar village approximately 10 km to the north of Duhok city. Animals were grazed in the pasture only. The pasture was containing a mix of meadow grass and leguminous plants. All lambs and kids were weighed at 10 days intervals at 10:00 a.m. On day 44, animals were slaughtered at the abattoir of the College of Agricultural Engineering Science, University of Duhok. Following the slaughtering process, the weight of a hot carcass, head, feet, skin, heart, spleen, lung and trachea, testes, testes fat, omental fat, mesenteric fat, cardiac fat, full digestive track were recorded. The carcasses then cooled at 4 $^{\circ}$C for 24 h.

Carcass traits and physical dissection

After cooling the carcasses for 24 h, the cold carcass weight was recorded, the kidney and the kidney pelvic fat were removed and weighed. Using an electric saw, each carcass was split along the vertebral column into two halves. The left side of the carcass was weighed and cut into nine commercial cuts namely: neck, shoulder, rack, shank, loin, breast, leg, flank and tail (31). The weight of each of these cuts was also recorded. The *longissimus dorsi* muscle area at the 12th rib was measured by tracing the muscle on semi-transparent paper and the area was measured using a Placom digital planimeter apparatus (PLANIX, TAMAYA digital planimeter). Fat thickness over the midpoint of the *longissimus dorsi* muscle was also measured using a Caliper device. The cuts of the left side of all animals were individually dissected into lean, bone and fat and the percentage of each component was calculated.

Statistical analysis

Data were analysed statistically using an ANOVA procedure of Genstat (GenStat version 17, VSN International Ltd, UK). The animal average daily gain was analysed as repeated measurement using factorial (2 × 2) (animal type × zeranol effect). Data on the total gain, slaughter and carcass characteristics, commercial cuts and physical dissection were analysed using a factorial (2 × 2) effect of animal types × zeranol implantation, with statistical general model as follows:

Yijk= μ +Ai + Bj+ ABk + eijk

Where: Yijk is the observation value of the animals, μ is the overall mean, Ai is the effect of zeranol implantation, Bj is the effect of animal species, ABk is the interaction between zeranol implantation and animal species and eijk is the experimental error.

RESULTS AND DISCUSSION

According to zeranol treatment manufacture (Ralgro® Implants for Beef Cattle), the effect of implanting zeranol treatment would remain active only for 42 days, and the current experiment was designed to study the effect of zeranol implantation on both animal groups, therefore the experiment was conducted for a short period (43 days) relatively. The live body weight of different treatment groups during the experimental period is shown in Figure (1). From Figure (1) it can be seen that the total growth rate during the 6 weeks of the experimental period was 4.25 and 5.85 kg for goat kids and Awassi lambs respectively. Zeranol implantation had no effect on the growth rate in both animal groups. The Awassi lambs have a higher growth rate compared to goat kids which probably due to the genetic parameters between both animal species. Table (1) shows that implanting GK and AL with zeranol had no significant effect on daily gain, initial and final weight and total gain, although the animals in the current experiment were implanted with the high dosage of zeranol (24 mg/animal). Werther lambs used in the present study have a heavier weight in both initial and final weight compared to GK (33.8, 40.0 and 19.0, 24.1 kg for AL and GK respectively). The low growth performance response for both lambs and goat kids to zeranol might be due to the high ambient temperature exposed to the animals during the experiment, as the current experiment was implanted from May 15th until June 27th during which the weather was hot (>35 $^{\circ}$C). In previous experiments conducted by Alkass and Kak, (4) Alkass and Mahmood (5) and Alkass and Dosky (2) who found that implanting low dosage (12 mg/animal) of zeranol either in lambs or goat kids had no effect on average daily gain, total gain or final weight. These studies also concluded that the lower response of the zeranol may be due to the high ambiance temperature condition (5).

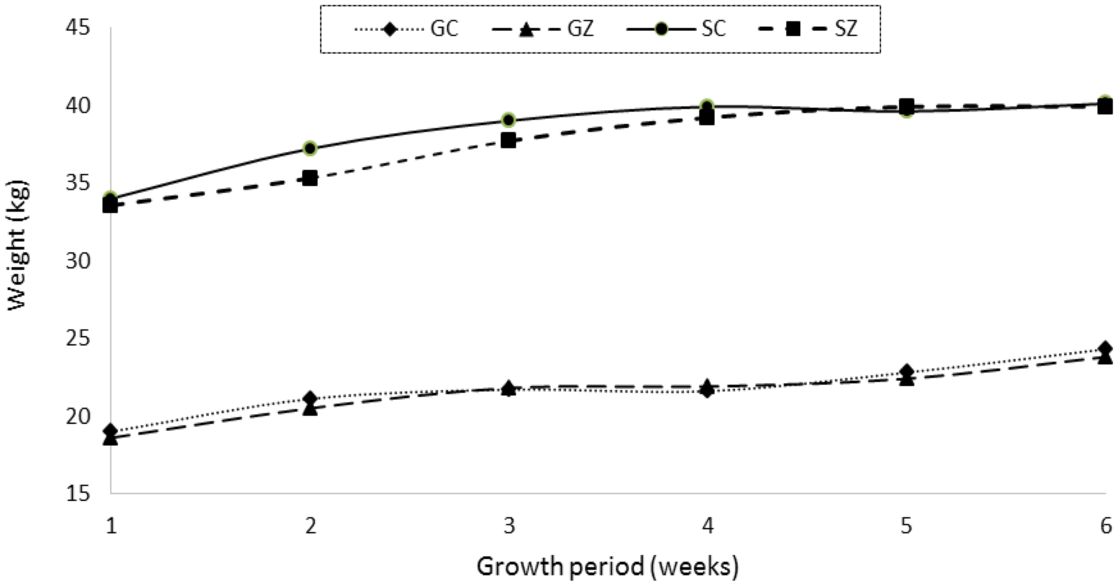

Figure 1. Effect of animal species and zeranol implantation on live body weight during the experiment. GC: goat kids' control, GZ: Goat kids zeranol, SC: lambs' control, SZ: lamb zeranol

Almost all lambs and goat kids' fattening periods in the northern part of Iraq (Kurdistan region) are conducted in late spring and summer when the temperature is above 30ºC especially in commercial flocks. Similar results were also reported by Sluiter et al. (28) who found that the effect of hormone implantation reduced during summer as compared to the winter when they implement lambs with zeranol in Texas USA which has similar weather conditions to Iraq (4, 5). The average daily gain (ADG) for goat kids was 102 g/day which was slightly higher than those reported earlier by Mayi and Alkass (20). They found that the ADG was approximately 80 g/day for black local goat kids when they fattened them for 90 or 150 days under experimental condition, while Alkass and Mahmood (5) found that the overall ADG for black goat kids was 140 g/day (which might be due to feeding the goat kids with concentrated diet). In the current study, animals were grazed in a pasture for only 42 days. The overall ADG for Awassi lambs was 140 g/day, this finding was lower than those reported by Alkass and Dosky (2) who found that the overall ADG for Awassi lambs was 210 g/day. Animal species have a significant effect ($P < 0.05$) on initial weight, growth rate and final weight due to mainly the genetic differences between Awassi lambs and local black goats (Table 1). As shown in Table (1), both implanted animal species with zeranol had no significant effect on all slaughter traits except testicular weight. Both zeranol groups had significantly ($P<0.05$) lighter weight as compared to the control groups (161, 71, 197 and 57 g for GC, GZ, SC, and SZ respectively). A similar result has been published by Field et al. (14) and Nold et al. (24) who indicated that treating lambs with 12 mg zeranol reduced the weight of the testes by 25-50% as compared to untreated lamb. This reduction might be due to the fact that implanted zeranol has facilitated changes in luteinizing hormone secretion (10) or due to the negative effect on gonadotropin secretion from the hypothalamus, hence, reduced testes growth (10). Implanting GK or AL with double zeranol dose (24 mg) did not affect all slaughter traits (Table 1). Similar results were found by EL-Hag et al. (13), who found that zeranol did not affect slaughter traits either with cattle or lambs. Animal types differed significantly in most slaughter traits (Table 1).

Table 1. Effect of animal types and zeranol implantation on growth, gain and slaughter traits

Traits	Goat kids		Awassi lambs		P-value			LSD	
	Control	Zeranol	Control	Zeranol	Zeranol	Animal	In.	Zeranol	Animal
Initial weight (kg)	19.1± 0.5	18.8±0.9	34.0±1.1	33.6±1.1	0.77	0.001	0.98	2.89	3.11
Final weight (kg)	23.5± 0.9	22.8± 1.2	40.1± 1.8	39.2± 1.5	0.53	0.001	0.98	3.20	3.51
ADG (g/day)	107± 20	97± 26	147± 25	133± 21	0.43	0.23	0.97	18.5	38.2
Total gain (kg)	4.5± 0.3	4.0± 0.4	6.1± 0.5	5.6± 0.4	0.43	0.27	0.97	0.81	1.75
Hot carcass (kg)	10.4± 0.8	10.1± 0.8	16.6± 1.2	16.1± 1.0	0.58	0.001	0.95	2.82	2.51
Dressing (%)	45± 2.0	44± 2.3	43±1.8	41± 1.9	0.39	0.24	0.22	2.89	3.52
Child carcass (kg)	10.1± 0.8	9.7± 0.9	16.1± 1.1	15.6± 1.3	0.61	0.001	0.98	1.75	1.94
Shrinkage (%)	2.9± 0.1	3.8± 0.5	3.0± 0.4	3.1 ± 0.1	0.81	0.07	0.38	0.62	1.11
Testes (g)	161±35	71± 15	197± 40	57± 12	0.001	0.41	0.07	24.1	25.5
Left side (kg)	4.9±198	4.7±102	7.1±245	7.3±294	0.91	0.01	0.63	1.12	1.25
Fat thickness (mm)	0.71±0.03	0.85±0.04	1.35±0.09	2.66±0.12	0.09	0.01	0.17	0.721	0.712
Reb eye area (cm^2)	8.1±0.9	7.1±0.8	11.2±1.0	12.6±0.9	0.83	0.002	0.21	1.21	1.22

Kg: kilogram, ADG: average daily gain, g: grams, %: percentage, mm: millimetre cm: centimetre, In.: interaction between zeranol and animal types, LSD: least significant differences.

Awassi lambs had a heavier initial and final weight, hot and cold carcass weight and carcass left side weight and fat thickness. These differences could be attributed to the fact that lambs used currently were heavier as compared to goat kids and the difference might be due to the genetic differences between sheep and goat. The total body fat for both goat kids and Awassi lambs were found to be 854 and 3125g respectively. Total body fat were partitioned into fat tail (0 and 58%), carcass fat (68 and 34%) and non-carcass fat (31 and 10 %) for GK and AL, respectively. Implanting both species of animals with zeranol found to deposit significantly lower total body fat by approximately 9 and 15% in GK and AL, respectively (Table 2). Testicular fat, the fat tail, omental and mesenteric fat were the main body fat that have been affected by zeranol implantation. While the results showed that treating animal groups with zeranol has trend a (P=0.07) to increased carcass fat as compared to control groups (Table 2). Alkass and Mahmood (5) observed similar results when they implanted local black goat kids either intact or castrated with 12 mg of zeranol. They found that zeranol implantation increased carcass fat and reduced non-carcass fat by 10% for both parameters. Hutcheson et al. (17) also noticed that implanted lambs with zeranol decreased yield grade, kidney, pelvic and heart fat. It has been reported by Koyuncu, et al. (19) that one of the main carcass value criteria is the fat distribution around the carcasses. The higher the subcutaneous fat (carcass fat) and lower the non-carcass fat the higher the carcass value. Additionally, producing carcasses with less body fat and higher lean would be more desirable by the consumers (4). The results obtained from the present experiment indicate that implanting AL and GK with zeranol increases the carcass value due to repartitions of fat and increasing (P=0.07) carcass fat (Table 2). Awassi lambs' groups were found to have more total body fat as compared to GK groups by 280%. The fat tail was the main fat adipose tissue in AL by approximately 60% of total body fat. While in goat kids' carcass fat was found to be the main total by fat by approximately 70%. Moreover, AL were found to have lesser (P<0.05) percentage of non-carcass fat including mesenteric, omental, cardiac, tests, kidney and pelvic fat compared to GK (Table 2). The differentiation in total body fat (both quantity and distribution) would probably due to the difference in genetic makeup between both species.

Table 2. Effect of animal types and zeranol implantation on body fat

Traits	Goat kids		Awassi lambs		P-value			LSD	
	Control	Zeranol	Control	Zeranol	Zeranol	Animal	In.	Zeranol	Animals
Total body fat (g)	892± 76	816± 96	3395± 423	2856± 524	0.01	0.08	0.21	270	265
Cardiac fat (%)	3.8± 0.5	2.9± 0.6	1.6± 0.03	2.3± 0.0.5	0.14	0.91	0.42	1.78	1.71
Omental and mesenteric fat (%)	18.9± 1.3	11.9± 1.6	6.2± 0.7	3.6± 0.5	0.02	0.08	0.49	1.49	3.42
Testicular fat (%)	0.6± 0.07	0.3± 0.02	0.3± 0.01	0.1± 0.02	0.01	0.001	0.52	0.06	0.06
Kidney and Pelvic fat (%)	9.5± 0.8	12.5± 0.9	3.0± 0.5	3.8± 0.4	0.17	0.32	0.45	2.21	4.10
Carcass fat (%)	67.1± 4.5	70.5± 7.1	28.9± 5.6	34.6± 3.8	0.07	0.11	0.95	5.73	6.78
Fat tail (%)			61.8± 2.8	54.4±4.2	0.01			1.82	
Total non-carcass fat (%)	32.7± 3.2	31.5± 3.8	11.0± 1.2	10.1± 1.3	0.11	0.11	0.12	2.25	2.71

In.: interaction between zeranol and animal types, LSD: least significant differences.

The results of carcass commercial cuts for all treatments are demonstrated in Table (3). The data explained that implanting both animal species with zeranol did not affect the percentages of cuts. However, AL showed to have a higher (P < 0.05) breast and neck percentage and have a lesser shoulder percentage compared to GK. Results of physical dissection of half carcass side revealed that the overall mean of lean, bone and fat percentages for GK were 60, 28 and 12.5, respectively and for AL were 60, 25.5 and 14.5, respectively. The physical dissection of the carcass for both animal species was within the normal reference range either for local Iraqi black goat kids (3,6 and 29) or for Awassi lambs (2, 4 and 25). It seems from the data given in Table (3) that implanting both animal species with high levels (24 mg/animal) of zeranol did not have any significant effect on physical dissection of the left side of the carcass. Similar results were obtained by several authors (8, 14 and 22) who found no significant differences in carcass composition between lambs treated with low level (12 mg/animal) of zeranol and untreated lambs. Although implanting both animal species with zeranol had no effect (P= 0.11) on total lean, there was a numerical increase in the lean ratio (61 vs 59%) for implanted animals with zeranol as compared to control animals respectively. Nasahlai et al. (22) hypothesized that zeranol promotes reservation of body protein, hence increasing the muscle protein. Estrogen promoters especially zeranol affect stimulating muscle growth in leg muscles (12). The results of physical dissection of the commercial cuts showed that both groups implanted with zeranol have a trend (P = 0.08) to increase the lean percentage of the left leg compared to untreated groups (67 vs. 63%) with no other significant differences. Sharp and Dyer (27) found an increase (P < 0.05) in body water and protein percentage and decrease (P < 0.05) body fat percentage. Whereas, other studies (3, 29 and 30) observed a slight effect of zeranol implantation on carcass composition.

Table 3: Effect of animal types and zeranol implantation on the percentage of commercials cuts and physical dissection of the left side of the carcass

Traits	Goat kids		Awassi lambs		P-value			LSD	
Cuts	Control	Zeranol	Control	Zeranol	Zeranol	Animal	In.	Zeranol	Animal
Left side w. (kg)	4.9±0.2	4.7 ±0.1	7.1±0.3	7.3±0.3	0.91	0.01	0.63	1.12	1.25
Breast (%)	8±0.4	8±0.3	9±0.7	9±0.7	0.68	0.04	0.89	2.0	1.1
Flank (%)	5±0.1	5±0.2	5±0.2	6±0.6	0.66	0.11	0.46	2.4	2.2
Loin (%)	8±0.8	7±0.8	7±0.9	6±0.7	0.42	0.15	0.41	3.2	3.2
Nick (%)	10±1.1	10±1.5	12±2.1	9±1.9	0.26	0.05	0.86	1.2	1.3
Rack (%)	9±1.2	8±0.9	8±1.5	11±2.3	0.51	0.13	0.13	1.2	1.3
Shank (%)	11±2.1	10±1.9	8±0.9	7±0.8	0.53	0.35	0.91	1.4	1.8
Shoulder (%)	17±1.8	20±4.6	19±5.6	17±4.7	0.78	0.08	0.51	3.2	2.9
Leg (%)	33±6.4	32±7.8	33±8.4	35±8.7	0.28	0.11	0.44	4.0	4.1
Total Bone (%)	29±5.6	26±5.9	26±8.4	24±4.8	0.17	0.07	0.87	5.6	5.5
Total Fat (%)	12±2.3	13±3.6	14±3.7	15±2.5	0.41	0.09	0.88	3.7	3.6
Total Lean (%)	59±9.8	61±11.2	60±10.3	61±10.9	0.11	0.61	0.55	4.1	4.3
Lean: bone ratio	2.0±0.2	2.3±0.3	2.3±0.5	2.5±0.3	0.11	0.42	0.77	0.41	0.45
Lean: fat ratio	5.7±1.1	5.1±0.9	4.3±0.7	4.1±0.7	0.44	0.04	0.35	2.32	2.51

W.: weight. In.: interaction between zeranol and animal types, LSD: least significant differences.

It can be concluded from the results obtained here that implanting either GK or AL with 24 mg zeranol had no significant effect on growth performance and most slaughter traits, while testes weight reduced in both animal groups treated with zeranol as well as total body fat. This reduction occurred due to decreasing in omental, mesenteric, testes and the tail fat percentage. The highest quantity reduction of body fat was found in the fat tail in AL. The main difference between both animal species used in the current study was the distribution of total body fat. Total non-carcass fat represents approximately 30% and 10% of total body fat for GK and AL respectively. Carcass fat represents approximately 70% and 30% of total body fat for GK and AL respectively, while fat tail represents 0% and 55% of total body fat for GK and AL respectively.

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