CHARACTERIZATION OF THE SINAI GABALI RABBITS IN TERMS OF MEAT PRODUCTION USING THE NEW ZEALAND WHITE AS A REFERENCE BREED

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ABSTRACT

Slaughtering and dissection data on 25 male Sinai Gabali rabbits serially slaughtered (at 4, 6, 8, 12 and 14 weeks of age) were used to characterize allometric growth patterns, composition and weight-distribution of empty body and carcass. A similar number of New Zealand White (NZW) rabbits were used as a reference breed.

Growth of body components relative to empty body weight (EBW), side entire joints relative to jointed side weight (JSW) and side major tissues relative to dissected side weight (DSW) were examined. The individual logarithmic regression slopes (growth coefficients) for Gabali and NZW rabbits were homogeneous for all body and carcass components and, thus, the common regression was used to represent the growth coefficient (b) for each component. Relative to EBW, the head, blood, feet, heart, lungs-plus-trachea, liver, alimentary tract, spleen and kidneys were early maturing (b<1), while, the pelt, abdominal fat and carcass were late maturing (b>1). As DSW increased the proportion of total side subcutaneous fat and total side intermuscular fat increased, that of total side bone and muscle to bone ratio decreased, while that of total side muscle remained almost without change (b=1). Relative to JSW, the fore limb was early maturing, while the other three joints (hind limb, loin and thoracic cage) followed an average pattern of growth (b=1).

At constant EBW, the Gabali rabbits had significantly (P<0.05) lighter carcass and abdominal fat and heavier pelt, heart, lungs-plus-trachea, liver and kidneys than the NZW. Comparing the two genotypes at equal DSW showed that the Gabali rabbits tend to have lower proportion of muscle and higher proportions of fat and bone. At constant JSW, the Gabali rabbits had higher proportions of hind limb, lower proportion of fore limb and similar proportions of loin and thoracic cage than the NZW. The paper related such results to physiological and behavioral patterns specific to the wild Gabali rabbits.

Key words. Gabali rabbits; allometric growth; composition and weight-distribution of empty body and carcass.

INTRODUCTION

In his description of rabbit genetic resources in Egypt, Khalil (1999) pointed out that there are two different strains of the wild Gabali rabbits in Egypt, one is found in the western desert on the north Mediterranean coast and the other in Sinai. The two strains are medium-sized and adapted to the desert conditions. Characterization of Gabali rabbits in terms of maternal traits, does reproductive performance, milk production and kid fattening performance have been described by Abd El-Aziz, (1998). Yet, published meat production data on these rabbits are quite scarce (Khalil, 1999).

The objective of the present study was to characterize allometric growth patterns, composition and weight-distribution of empty body and carcass of serially slaughtered Sinai Gabali rabbits using the NZW rabbits as a reference breed.

MATERIALS AND METHODS

The present study was carried out within the frame work of a characterization research project on Gabali rabbits joining the Desert Research Center (DRC), the Animal Production Research Institute (APRI) and the Ain Shams University, Faculty of Agriculture (ASUFA) and funded by the National Specialized Councils (NSC).

Animals*:*

Twelve Gabali bucks and fifty Gabali does were hunted from north Sinai and then transferred to the Experimental Rabbit Farm at the Ain Shams University Faculty of Agriculture where they were housed and bred in individual cages. Twenty-five weanling males were taken from the first generation and housed in fattening cages. A control group of Twenty-five weanling New Zealand White males were housed under the same conditions.

Feeding and management:

A grower diet providing 16% crude protein, 14% crude fiber, 2% crude fat and 2600 K.cal. digestible energy/ kg diet was given to rabbits from weaning at 4 weeks of age up to slaughtering. Feed and water were provided *ad libitum* and the conventional brooding and rearing practices were adopted.

Slaughter and carcass characteristics:

Serial slaughtering at 4, 6, 8, 12 and 14 weeks of age (5 animals from each breed at each age point) was practiced. Animals were sacrificed by severing the carotid artery and jugular veins and the non-carcass components were separated individually. The blood weight was estimated by subtracting the dead weight from the live weight. The head was removed at the atlanto-occipital articulation, the front and hind feet at the proximal end of the metacarpus and metatarsus, respectively. The pelt was removed and the carcass eviscerated (Blasco et al.,1992) and all visceral offal components were separated individually. The hot dressed carcass was weighed, packed in plastic bags and stored in a deep freezer (-18 ºC) until dissection. The empty body weight (EBW) was estimated by summing up the weight of the dressed carcass and the weight of the non-carcass components. The carcass was thawed and splitted and the right side was separated (Blasco et al.,1992) into four joints, viz. hind limb, fore limb, loin and thoracic cage. By totaling the weights of the side joints, the jointed side weight (JSW) was obtained. Each joint was separated into subcutaneous fat (SCF), muscles, intermuscular fat (IMF) and bones. By summing up the weight of each tissue over all the side joints, the side muscle, the side SCF, the side IMF and the side bone were estimated. Summing up these totals gives the dissected side weight (DSW).

Statistical analysis:

The data describing weights of body and carcass components were analyzed using the Statistical Analysis Systems (SAS) of Barr et al.(1976) according to the following logarthmic form of the allometric relationship $Y = a X^b$:

$$\mathbf{Log\ Y_{ij} = A_o + G_i + b\ Log\ X_{ij} + E_{ij}}$$

where:

Y_{ij} = The weight in grams of the component Y for the j^{th} rabbit from the i^{th} genotype-group;

A_o = is the intercept;

G_i = The fixed effect of the i^{th} genotype-group (i=1,2);

X_{ij} = The weight in grams of the independent variable for the j^{th} rabbit from the i^{th} genotype-group;

b = is the allometric regression coefficient of log Y on log X (growth coefficient);

E_i = is the error assumed to be NID (0, σ_e^2).

RESULTS AND DISCUSSIUON

A. Characterization of allometric growth patterns

The individual logarithmic regression slopes (growth coefficients) for New Zealand White and Gabali rabbits were homogeneous for all body and carcass components and, thus, the common regression slope was used to represent the growth coefficient for each component (Table 1).

The non-carcass components:

Generally, the vital components such as the head, blood, heart, lungs, liver, alimentary tract, spleen and kidneys tended to have growth coefficients less than 1. This indicated that these components were early maturing and their proportions decreased as the empty body weight increased. The pelt and abdominal fat, on the other hand, had growth coefficients greater than 1, which indicated that they were late developing and their proportions increased as the empty body weight increased.

Deltoro and Lopez (1985) have reported the early maturity of head, spleen and kidneys in rabbits. The rapid development of alimentary tract (Table 1; Rao et al., 1978) should be related to the fact that young rabbits begin to eat solid feed at around the age of 3 weeks (Lebas *et al.*, 1986). The high relative growth rate of liver (Table 1; Deltoro and Lopez, 1985) may be associated with the feeding pattern of young rabbits in relation to the formation and storage of starch; young animals having relatively lower utilization of energy as compared with the old (Rao *et al.*, 1978).

Table 1: Estimates of growth coefficient (b) in the allometric regression of proximate body and carcass side components

Dependent variate (log Y)	Independent variate* (log X)	Gabali		NZW		Common		R^2
		b	SE	b	SE	b	SE	
Weight of non-carcass components:								
Head	EBW	0.58	0.08	0.64	0.06	**0.60**	0.06	0.85
Feet	EBW	0.79	0.08	0.70	0.07	**0.73**	0.06	0.75
Pelt	EBW	1.39	0.09	1.32	0.08	**1.33**	0.08	0.90
Blood	EBW	0.69	0.16	0.74	0.14	**0.70**	0.13	0.58
Heart	EBW	0.80	0.05	0.73	0.04	**0.77**	0.03	0.75
Lungs-plus-trachea	EBW	0.88	0.23	0.78	0.13	**0.82**	0.18	0.89
Liver	EBW	0.93	0.03	0.85	0.04	**0.90**	0.02	0.90
Kidneys	EBW	0.70	0.06	0.85	0.03	**0.80**	0.03	0.82
Spleen	EBW	0.70	0.15	0.61	0.09	**0.64**	0.12	0.78
Digestive tract	EBW	0.92	0.20	0.83	0.12	**0.88**	0.15	0.88
Abdominal fat	EBW	3.31	0.91	3.77	0.96	**3.65**	0.55	0.58
Weight of carcass and carcass components:								
Dressed carcass weight	EBW	1.03	0.06	1.09	0.04	**1.08**	0.03	0.90
Side hind limb cut	JSW	1.02	0.06	0.96	0.04	0.96	0.03	0.95
Side loin cut	JSW	1.07	0.07	1.09	0.04	1.07	0.04	0.95
Side fore limb cut	JSW	0.88	0.06	0.90	0.05	**0.81**	0.05	0.90
Side thoracic cage cut	JSW	0.91	0.08	0.99	0.12	**0.99**	0.08	0.80
Side muscle	DSW	1.03	0.02	1.02	0.01	1.03	0.01	0.90
Side subcutaneous fat	DSW	1.71	0.39	1.99	0.33	**1.99**	0.32	0.78
Side intermuscular fat	DSW	1.84	0.26	1.76	0.26	**1.86**	0.21	0.71
Side bone	DSW	0.70	0.06	0.75	0.04	**0.53**	0.04	0.88
Side muscle-to-bone ratio	DSW	0.55	0.03	0.52	0.05	**0.50**	0.04	0.62

***: EBW= empty body weight, JSW= jointed side weight, DSW= dissected side weight. Growth coefficients in bold face are significantly different from 1 at P<0.05.**

The late maturity of pelt could be explained in light of the penetration of lipids inside the derm in the later stages of growth (Rao *et al.*, 1978; Deltoro and Lopez, 1985). The late maturity of abdominal fat relative to empty body weight has been emphasized by Vezinhet and Prud'hon (1975).

The carcass:

The carcass had a growth coefficient greater than 1, indicating that it is late developing and its proportion increased as the empty body weight increased. The late maturity of the rabbit carcass has been previously reported (Aboul-Seoud *et al.*, 1970; Dilella and Zicarelli, 1971; Rao *et al.*, 1978; Zelnik *et al.,* 1981; Damyanova *et al.*, 1985).

The carcass joints:

The allometric equation was used to relate the increase in the weight of each of the four joints considered to the increase in the weight of the jointed side (JSW) and the results of the regression analysis are given in Table 1. As JSW increased the proportion of fore limb decreased (b<1), while that of hind limb, loin, and thoracic cage remained almost without change (b=1). These results indicate the early maturity of fore limb and the intermediate maturity of the other entire joints.

The carcass major tissues:

Table 1 gives also the results of the regression analysis of the logarithm of the weight of carcass major tissues and muscle to bone ratio on the logarithm of dissected side weight (DSW). As DSW increased the proportion of total side subcutaneous fat and total side intermuscular fat increased (b>1), that of total side bone and muscle to bone ratio decreased (b<1), while that of total side muscle remained almost without change (b=1). Previous reports on rabbits showed the early maturity of bone (Prud'hon et al., 1970) and the late maturity of muscle and fat (Deltoro and Lopez, 1985).

B. Characterization of body and carcass composition and carcass-weight distribution

Table 2 and Fig. 1 give the genotype means of the weight of each proximate body component adjusted to equal empty body weight, the weight of each entire joint adjusted to equal jointed side weight and the weight of each major carcass tissue adjusted to equal dissected side weight, using the corresponding common regression equations.

Table 2: Adjusted means antilog of proximate body and carcass components for Gabali (GAB) and New Zealand White (NZW) rabbits

Dependent variate (log Y)	Independent variate= (log X)	Adjusted means antilog (gm) ==		Level of significance
		GAB	NZW	
Weight of non-carcass components:				
Head	EBW	85.39	84.83	ns
Feet	EBW	38.36	39.83	ns
Pelt	EBW	124.65	112.84	**
Blood	EBW	32.29	31.95	ns
Heart	EBW	3.71	2.70	**
Lungs-plus-trachea	EBW	15.08	11.93	**
Liver	EBW	42.08	37.69	*
Kidneys	EBW	6.41	6.98	ns
Spleen	EBW	0.92	0.90	ns
Digestive tract	EBW	86.96	75.38	*
Abdominal fat	EBW	13.28	14.85	*
Weight of dressed carcass and carcass components:				
Dressed carcass	EBW	575.66	587.36	*
Side hind limb cut	JSW	147.30	133.53	*
Side loin cut	JSW	123.29	122.07	ns
Side fore limb cut	JSW	53.34	60.99	*
Side thoracic cage cut	JSW	39.43	39.04	ns
Side muscle	DSW	288.90	294.74	**
Side subcutaneous fat	DSW	5.36	3.01	**
Side intermuscular fat	DSW	8.41	5.85	**
Side bone	DSW	41.12	39.08	**
Side muscle-to-bone ratio	DSW	7.03	7.54	**

=: EBW= empty body weight, JSW= jointed side weight, DSW= dissected side weight.
==: Adjusted to geometric mean of : EBW= 1125 gm, JSW= 359.44 gm, DSW = 345.86 gm.
ns not significant ,* P< 0.05, ** P<0.01.

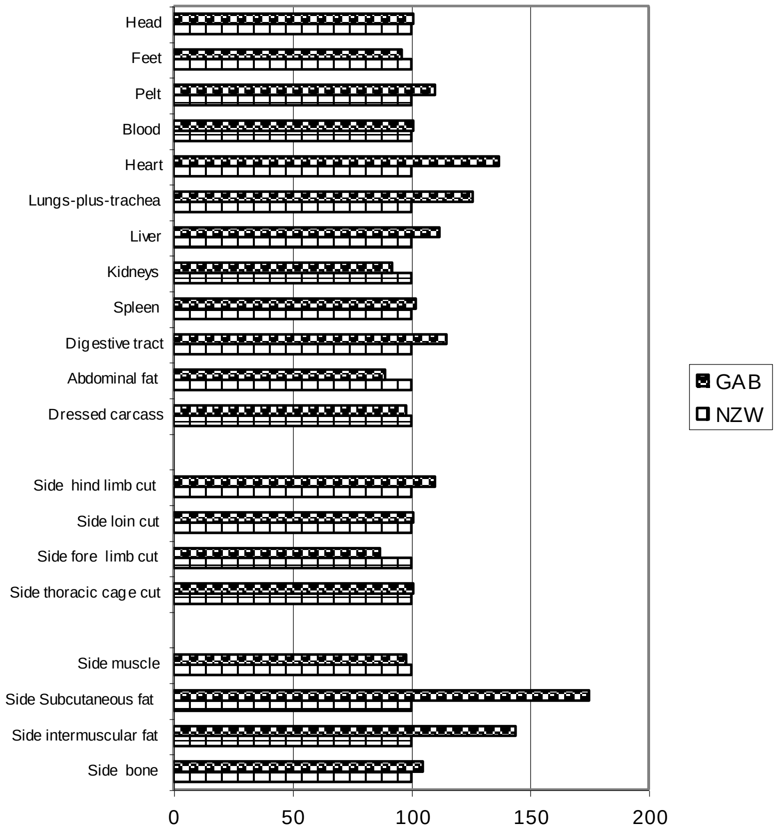

Fig 1: Weights of empty body components, carcass side cuts and carcass side tissues in Gabali (GAB) rabbits as percentage of the corresponding values in New Zealand White NZW); comparisons made at equal weights of covariates (Table 2).

The composition of the empty body:

At equal empty body weight, the Gabali rabbits had significantly lighter abdominal fat and carcass ($P<0.05$) and heavier pelt, heart, lungs-plus-trachea, liver and kidneys than the NZW. The higher proportions of blood, heart and lungs-plus-trachea in Gabali rabbits reflect their need for higher blood oxygen capacity.

The distribution of carcass weight between joints:

No significant differences ($P>0.05$) were found between the Gabali and New Zealand White rabbits in the contributions of loin and thoracic cage joints to carcass weight. As compared to the New Zealand White at constant JSW, the Gabali rabbits were found to have higher ($P<0.05$) proportion of hind limb and lower proportion of fore limb. This pattern of distribution could be associated with the need of Gabali rabbits for faster movement and more flexibility in changing direction in the wild environment.

The composition of the carcass:

The two genotypes under study differ significantly ($P<0.01$) in carcass composition. As compared to the New Zealand White, the Gabali rabbits tend to have lower proportion of muscle and higher proportion of bone and consequently lower muscle to bone ratio. The higher proportions of subcutaneous and intermuscular fats in Gabali rabbits in the present study indicate that the level of energy provided to such wild animals (2600 K.cal. digestible energy/ kg diet) is higher than their basic nutritional requirements.

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توصيف أرانب سيناء الجبلية من زاوية إنتاج اللحم باستخدام الأرانب النيوزيلندي البيضاء كسلالة مرجعية

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استخدمت بيانات ذبح وفصل أنسجة مأخوذة على25 ذكر من سلالة الأرانب الجبلية المذبوحة فى تسلسل عمرى عند 4 ، 6 ، 8 ، 12 ، 14 أسبوع لتوصيف أنماط النمو الألوميترى وكذا التكوين والتوزيع الوزنى لجسم الأرنب الفارغ و الجانب الأيمن للذبيحة. وقد استخدم عدد مساو من سلالة النيوزيلندي الأبيض كأساس للمقارنة.وقد تمت دراسة نمو مكونات الجسم (منسوبة الى نمو الجسم الفارغ) ونمو القطعيات المفصولة من جانب الذبيحة (منسوبة الى نمو إجمالي وزن قطعيات جانب الذبيحة) وكذلك نمو مكونات الذبيحة (منسوبة الى نمو إجمالي وزن الأنسجة المفصولة من جانب الذبيحة).

وقد اتضح أن معاملات النمو (انحدار) الفردية لكل من الأرانب الجبلية والنيوزيلندية كانت متجانسة لكل مكونات الجسم والذبيحة ولذلك تم استخدام الانحدار المشترك ليمثل معاملات النمو لهذه المكونات. وقد أوضحت قيم معاملات النمو المتحصل عليها مايأتى:

- مكونات الجسم ذات الارتباط بحياة الحيوان مثل الرأس والدم والأرجل والقلب والرئتين والقصبة الهوائية والكبد والقناة الهضمية والطحال والكلى هى مكونات مبكرة النضج بينما الفروة ودهن البطن والذبيحة ككل متأخرة النضج.
- دهن الذبيحة سواء كان دهن الغطاء أم دهن بين العضلات متأخرا فى النضج وأن العظام وكذا نسبة العضلات الى العظام مبكرة فى النضج بينما العضلات متوسطة.
- قطعية الرجل الأمامية مبكرة فى النضج بينما القطعيات الأخرى (الرجل الخلفية والقطن والصدر) متوسطة.

وقد أوضحت مقارنة الأرانب الجبلية مع الأرانب النيوزيلندية البيضاء أن:

- على وزن ثابت للجسم فان الأرانب الجبلية تحتوى على نسبة أقل من دهن البطن والذبيحة ونسبة أعلى من الفروة والقلب والرئتين والقصبة الهوائية والكبد والكلى.
- على وزن ثابت لإجمالي قطعيات جانب الذبيحة فان الأرانب الجبلية تحتوى على نسبة أعلى من وزن جانب الذبيحة فى الرجل الخلفية ونسبة أقل فى الرجل الأمامية ونسبة مساوية فى القطن والصدر.
-على وزن ثابت لإجمالي وزن أنسجة جانب الذبيحة فان الأرانب الجبلية تحتوى على نسبة أعلى من دهن الغطاء ودهن بين العضلات والعظام ونسبة أقل من العضلات. ولقد ربطت الدراسة النتائج المتحصل عليها بالأنماط الفسيولوجية والسلوكية الخاصة بالأرانب الجبلية.