Egyptian Journal of Rabbit Science,12 (2):155-164 (2002)

EVALUATION OF CARCASS COMPOSITION OF NEW ZEALAND WHITE RABBITS RAISED IN TWO DIFFERENT HOUSING SYSTEMS

M. R. Anous[1], M. Mourad[1] and M. S. Ayyat[2]

[1]Department of Animal Production, Faculty of Agriculture, Ain-Shams University, P.O. Box 68 Hadayek Shoubra,11241 Cairo, Egypt.

[2]Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

Data were recorded for 102 male rabbits, progeny of 19 sires and 102 dams of New Zealand White breed, raised in two different housing systems (University as opened housing system and Company as closed housing system) in Sharkia Governorate, Egypt. All rabbits were slaughtered when reached approximately 2 kg live weight to evaluate the effect of housing system on carcass composition of rabbits and the possibility of increasing their meat production through mass selection.

Least squares analysis of variance showed that slaughter weight, hot carcass weight, fat yield in hind leg, loin and chuck cuts and bone yield in fore leg and loin cuts were significantly ($P<0.05$ or 0.01) affecting by different housing systems. Differences in weight-distribution traits between the two housing systems may be explained by differences in climatic and managerial conditions. Generally, the magnitude of genetic estimates reflects the possibility of improving rabbit carcass composition through direct selection on slaughter weight. It would lead to increase hind leg cut muscle yield by 0.13% and decrease both loin and chuck cut fat yields by 0.13% and 0.19%, respectively, while an increase in fore leg cut bone yield was observed (+0.27%).

Key words: Carcass composition, rabbits, selection, housing systems.

Rabbit production on a relatively small scale, involving minimal inputs, could make a substantial contribution to the supply of animal protein for human consumption in developing countries. Rabbits are already being bred for meat in many of these countries and in some, rabbit meat production is being actively encouraged and supported by the government. This involves the use of large numbers of rabbits of improved breeds and strains, scientifically balanced and pelleted feeds, and strictly controlled environmental conditions.

Important traits in meat rabbit production are those related to growth, reproduction and rusticity, including resistance to digestive and respiratory diseases (Baselga, 1990). Furthermore, Varewyck *et al.* (1987) reported that most important traits to consider with regard to slaughter yield are percent of back and thighs and the ratio of meat to bone of the back and thighs. The characteristics of the total body growth and the relative growth of different body parts of rabbits are described by Ouhayoun (1983). He showed that there is a large genetic variability, both between and within breeds, of the parameters of growth: final conformation, speed and precocity of growth and body composition. Also, maternal effect, litter size, parity, the local climate (i.e. temperature, humidity, photo-period), the microclimate of breeding, the fattening systems and the nature of the utilized materials had an important influence on the growth of rabbits (Eberhart, 1980; Prud'Hon, 1976; Colin, 1974; Camps, 1976; Reyne *et al.*, 1978; Baselga, 1978). Housing systems had also an effect on the growth of rabbits and consequently their carcass composition (Lebas *et al.*, 1986; Lebas and Ouhayoun, 1987).This variability makes possible a very diversified production, in a qualitative sense, and presents numerous possibilities for selection.

Domestic commercial rabbit producers in Egypt use purebred New Zealand White and, to a lesser extent, Californian breeds of U.S. origin. Despite its medium size, the apparent body muscularity of the New Zealand White rabbits could be improved, to the profit of rabbit meat producers, via selection.

The objective of the present study was to compare slaughter and carcass composition traits of the New Zealand White rabbits raised in two different housing systems and the possibility of applying mass selection to increase their meat production potentiality under the Egyptian conditions.

MATERIALS AND METHODS

Animals:

Data of 102 male rabbits, born in 1993 in the same season, randomly sampled from progeny of 19 sires and 102 dams of New Zealand White breed were used in the present study. Animals were raised in two farms of different housing systems in Sharkia Governorate, Egypt. The number of 12 sires, 63 dams and 63 of their male offspring were raised in the farm of the Faculty of Agriculture, Zagazig University in opened housing system (i.e.University housing system) and 7 sires, 39 dams and 39 of their male offspring were raised in the farm of San El-Hager Investment Company for Agriculture and Food Security in closed housing system (i.e.Company housing system). In the University farm, rabbits were reared inside a building with windows used for natural ventilation and lighting. In winter, windows in the northern side of the building were closed to protect rabbitry against wind. Inside temperatures and humidity varying from 18°C and 80%, respectively (in winter) to 35°C and 70%, respectively (in summer).

A 14:10h light:dark daily photoperiod cycle was maintained. In the Company farm, rabbits were reared inside closed buildings, which were provided with electronic fans . Air was condititioned either in winter or in summer by ventilation to keep the temperature allover the year round 20-24 °C, while relative humidity was round 70±50%. A cycle of 16h light: 8h dark was used with controlled artificial lighting, during the exiperimental period.

Management and traits considered:

Rabbits were identified at weaning at about 35 days of age and weighed. They were reared in wire-mesh cages, in a flat deck arrangement, fitted with metal feeders and nipple drinkers. They fed, ***ad libitum***, for approximately 60 days, on commercial pelleted ration with 16.3% crude protein, 12.44% crude fiber and 2670 kcal digestible energy/kg diet according to NRC (1977) till they attained the slaughter weight of approximately 2 kg. Slaughter weights of the rabbits were recorded (in grams) after an overnight fast. After complete bleeding, the animals were dressed according to Ayyat *et al.* (1994) into 5 cuts, viz., fore leg, chuck (including neck and thoracic cage), abdominal wall, loin and hind leg cuts (including sacral bone). Cuts were then dissected into muscle, fat and bone. Weights of these tissues were recorded (in grams), then they expressed separately on a percentage basis from the side muscle, fat and bone weights, respectively. Side muscle, fat and bone weights represent, respectively, the sum of dissected muscles, fats and bones of all cuts of the right side.

Statistical analysis:

The data were analyzed by Least-squares and Maximum Likelihood Program (Harvey, 1990), using the following mixed model:

$$Y_{ijk} = \mu + H_i + (s{:}H)_{ij} + e_{ijk} ,$$

where: Y_{ijk} = Observation on the k^{th} rabbit raised in the i^{th} housing system and sired by the j^{th} sire; μ = Overall population mean; H_i = Fixed effect of the i^{th} housing system (i =1,2); $(s{:}H)_{ij}$ = Random effect of the j^{th} sire within the i^{th} housing system (j =1,.....,19); e_{ijk} = Random error.

The correlated response(CR) of a trait Y,when mass selection is applied on slaughter weight (X) was calculated according to Falconer (1989) as follows:

$$CR_Y = i\, h_x\, h_y\, r_G\, \sigma P_{(Y)} ,$$

where: i is the intensity of selection (=Selection differential/Phenotypic standard deviation of the trait x); h_x and h_y is the square root of the heritability of the traits X and Y, respectively; r_G is the genetic correlation between X and Y;$\sigma P_{(Y)}$ is the phenotypic standard deviation for the trait Y.

The selection differential of the selected trait (i.e. slaughter weight) was taken to be one phenotypic standard deviation. A paternal half-sib analysis was used to estimate phenotypic and genetic parameters.

RESULTS AND DISCUSSION

Least squares means:

Significant differences between rabbits in the two housing systems were observed (Table 1) for slaughter weight ($P<0.01$), hot carcass weight ($P<0.05$), hind leg ($P<0.05$), loin ($P<0.01$) and chuck ($P<0.05$) cuts fat yield, and fore leg and loin cuts bone yield ($P<0.001$). These differences could be explained by the differences between the two farms in managerial and housing conditions especially inside temperature, humidity and lighting. Sires within housing system showed practically no significant effect ($P>0.05$) in all traits considered except hind leg cut muscle yield ($P<0.05$). It seems from these results that some slaughter and weight-distribution traits of rabbits were significantly affected by different housing systems.

Many factors can, generally, affect carcass composition of rabbits. Ouhayoun and Cheriet (1983) concluded that body composition in rabbits was highly affected by the genetic and dietary factors. Also, Lebas and Ouhayoun (1987) reported that most growth and body composition traits were affected by dietary protein levels, housing conditions and seasons. In our study, although the two farms differed in housing and managerial conditions, they provided rabbits with similar protein intake. This should put in evidence the importance of considering housing conditions when evaluating rabbits for carcass merit.

Male rabbits in the University housing system tended to have a higher slaughter weight (+138g), hot carcass weight (+65g), hind leg cut fat yield (+2.28%) and fore leg cut bone yield (+1.89%) and a lower loin and chuck cuts fat yield (-3.35% and –3.58%, respectively) and loin cut bone yield (- 4.18%) when compared to male rabbits in the Company housing system. The results of the present study indicated also that the parts of the carcass with most muscle (Table1) are the hind leg with the highest yield followed by the chuck. These two parts showed also the highest bone and fat yields. The fat deposition is more important in the chuck cut than in the hind leg cut.

Genetic parameters:

Heritability estimates (h^2) for the traits considered in the study,based on paternal half sib variance components, are given in Table 2.Generally,heritability showed medium estimates, which justify the need for selection for improving these traits. The high values of SE obtained for heritability estimates could be explained by the small number of animals

Table 1: Least-squares means (LSM) with their standard errors (±SE) and means squares in the analysis of variance for slaughter and weight-distribution traits.

Traits	LSM† ±SE			Means squares ‡		
	Overall	Opened housing system	Closed housing system	Housing system	Sire/Housing system	Residual
i. Slaughter traits:						
Slaughter weight (g)	2116±20.22	2185^{a}±24.94	2047^{b}±.31.89	45423.04^{**}	37447.64^{NS}	23463.22
Hot carcass weight (g)	1247±14.06	1279^{a}±17.34	1214^{b}±22.17	102404.65^{*}	18116.51^{NS}	11468.02
Carcass yield (%)	58.96±0.22	58.55±0.27	59.38±0.34	16.42^{NS}	4.27^{NS}	4.55
ii. Weight distribution traits:						
A) Muscle (%):						
Hind leg cut muscle yield	40.87±0.31	40.73±0.38	41.01±0.49	1.85^{NS}	8.90^{*}	4.86
Fore leg cut muscle yield	14.27±0.31	14.43±0.39	14.11±0.49	2.48^{NS}	6.32^{NS}	9.53
Loin cut muscle yield	17.16±0.43	17.19±0.53	17.13±0.67	0.08^{NS}	15.27^{NS}	17.57
Abdominal wall cut muscle yield	8.48±0.20	8.23±0.24	8.73±0.31	6.08^{NS}	3.64^{NS}	2.51
Chuck cut muscle yield	19.85±0.31	19.76±0.39	19.55±0.49	35.46^{NS}	9.42^{NS}	8.79
B) Fat (%):						
Hind leg cut fat yield	26.12±0.71	27.26^{a}±0.88	24.98^{b}±1.12	125.18^{*}	19.90^{NS}	48.67
Fore leg cut fat yield	21.92±0.77	22.14±0.95	20.71±1.21	142.36^{NS}	44.85^{NS}	57.10
Loin cut fat yield	16.18±0.66	14.50^{b} ±0.81	17.85^{a} ±1.03	269.71^{**}	40.05^{NS}	29.01
Abdominal wall cut fat yield	7.34±0.45	7.70±0.55	6.97±0.71	12.84^{NS}	18.65^{NS}	12.15
Chuck cut fat yield	29.07±0.87	26.88^{b}±1.07	30.46^{a}±1.36	186.07^{*}	32.31^{NS}	72.70
C) Bone (%):						
Hind leg cut bone yield	42.59±0.76	43.19±0.94	41.98±1.19	35.25^{NS}	54.37^{NS}	47.67
Fore leg cut bone yield	16.23±0.28	17.17^{a}±0.35	15.28^{b}±0.45	85.43^{***}	7.44^{NS}	4.85
Loin cut bone yield	10.92±0.58	8.83^{b}±0.73	13.01^{a}±0.92	918.28^{***}	19.71^{NS}	32.90
Chuck cut bone yield	30.89±0.96	31.14±1.18	30.63±1.51	6.26^{NS}	83.68^{NS}	50.74

†Means in the same raw with different superscripts are different at P<0.05.
‡ NS (P>0.05);* (P<0.05); ** (P<0.01); *** (P<0.001).

Table 2: Heritabilities with their standard errors (h^2±SE) and genetic (r_G±SE) and phenotypic (r_P) correlations between slaughter weight and weight-distribution traits†.

Traits	h^2±SE	r_G‡±SE	r_P‡
Slaughter weight (g)	0.37±0.36	----	----
Hind leg cut muscle yield (%)	0.48±0.38	0.32±0.56	0.26
For leg cut muscle yield (%)	----	----	0.06
Loin cut muscle yield (%)	----	----	0.10
Abdominal wall cut muscle yield(%)	0.29±0.34	-0.38±0.36	-0.21
Chuck cut muscle yield (%)	0.05±0.28	-0.23±0.51	-0.03
Hind leg cut fat yield (%)	----	----	-0.14
Fore leg cut fat yield (%)	----	----	0.07
Loin cut fat yield (%)	0.25±0.33	-0.24±0.82	-0.12
Abdominal wall cut fat yield (%)	0.34±0.35	-0.41±0.88	-0.20
Chuck cut fat yield (%)	----	----	0.04
Hind leg cut bone yield (%)	0.10±0.30	0.11±0.17	0.19
Fore leg cut bone yield (%)	0.34±0.35	0.87±0.63	0.21
Loin cut bone yield (%)	----	----	0.01
Chuck cut bone yield (%)	0.39±0.36	-0.09±0.75	-0.19

† Negative variance component estimates set to zero for these computations.
‡ Genetic and phenotypic correlation values equal to or greater than 0.19 are significant at $P<0.05$.

used in the study. For weight- distribution traits, hind leg cut muscle yield was the most heritable trait (h^2 = 0.48) followed by chuck cut bone weight (h^2= 0.39). Ferraz *et al.* (1991) recorded a heritability estimate of 0.53 for marketing body weight at 77 days of age in New Zealand White rabbits, however, a very low estimate of 0.03 was obtained by Darwish *et al.* (1970) for Giza White rabbits slaughtered at 90 days of age. Lukefahr (1988) reported higher heritability of 0.60 for hind cut meat weight.

The genetic and phenotypic correlation coefficients between slaughter weight and weight-distribution traits are also given in Table (2). Genetic correlations showed moderate to high significant values ($P<0.05$) with slaughter weight. This is going with the findings of Gabriel *et al.* (1989) and Anous (2000). Generally, genetic improvement of slaughter weight would seem to go along with the improvement in hind leg cut muscle yield (r_G= +0.32). It would moderately decrease the percentage abdominal (r_G =-0.38) and chuck (r_G = -0.23) muscles and also the percentage loin (r_G = -0.24) and abdominal fat (r_G = -0.41). It seems to go along with increasing the fore leg cut bone yield (r_G = +0.87).

Mass selection:

Correlated response (CR) for weight-distribution traits expected from selection on slaughter weight of rabbits are shown in Table (3). It seems that mass selection for increasing slaughter weight one gram would lead to increase hind leg cut muscle yield and fore leg cut bone yield by 0.13% and 0.27%, respectively. . It should lead to decrease chuck cut bone yield by 0.10%. At the same time, it should lead to decrease abdominal wall cut muscle yield by 0.07% and both loin and chuck cuts fat yield by 0.13% and 0.19%, respectively. Thus, mass selection could be effective for modify rabbit carcass composition. This agrees with the findings of Anous (2000).

Table 3: Correlated responses (CR) expected from selection on slaughter weight.

Traits	CR
Slaughter weight (g)	----
Hind cut muscle yield (%)	0.13
Fore leg cut muscle yield (%)	----
Loin cut muscle yield (%)	----
Abdominal wall cut muscle yield (%)	-0.07
Chuck cut muscle yield (%)	-0.01
Hind leg cut fat yield (%)	----
Fore leg cut fat yield (%)	----
Loin cut fat yield (%)	-0.13
Abdominal wall cut fat yield (%)	-0.19
Chuck cut fat yield (%)	----
Hind leg cut bone yield (%)	0.03
Fore leg cut bone yield (%)	0.27
Loin cut bone yield (%)	----
Chuck cut bone yield (%)	-0.10

Concusivly, It could be concluded that mass selection for increasing slaughter weight of rabbits would be effective for improving some weight-distribution traits.

REFERENCES

Anous, M. R. (2000). Genetic improvement of meatiness of local rabbits in Burundi. *Egypt. J. Rabbit Sci.*, **10:** 183-194.

Ayyat, M. S., Anous, M. R. and Sadek, M. H. (1994). Genetic parameters for meat production in rabbits. 1- Non carcass components. *World Rabbit Sci.*, **3**: 93-99.

Baselga, M. (1978). Analysis genitico de diversas caracteristicas de crecimiento en el conejo de produccion de carne. *III^{eme} symposium de cunicultura*, Valencia, 9 Novembre.

Baselga, M. (1990). Genetic analysis models and selection in small populations of meat rabbits. *Options Méditerranéennes. Série Séminaires*, **8:** 35-39.

Blasco, A., Ouhayoun, J. and Masoero, G. (1992). Status of rabbit meat and carcass: criteria and terminology. *Options Méditerranéennes, Série Séminaires*, **17:** 105-120.

Camps, J. (1976). Environmental humidity and its relationships with rabbit pathology. *Le Congrès International Cunicole*, 31 Mars-2 Avril 1976, Dijon, France.

Colin, M. (1974). Variabilité des performance obtenus chez le lapin avec un aliment de composition constante. *Journées I.T.A.V.I.*

Darwish, H.I., Mostageer, A. and Ghany, M.A. (1970). Genetic and phenotypic parameters of carcass characteristics in Giza rabbits. *U.A.R. Journal of Animal Production*, **10:**13-19.

Eberhart, S. (1980). Influence of environmental temperature on meat rabbits of different breeds. *Proc. II^{ème} Congrès Mondial de Cuniculture*, Barcelone, Avril 1980, Vol. **1**, 399-409.

Falconer, D.S. (1989). *Introduction to Quantitative Genetics* (3rd Ed.). John Wiley & Sons, New York, 365p.

Ferraz, J.B.S., Johnson, R.K. and Eler, J.P. (1991). Genetic parameters for growth and carcass traits of rabbits. *J. Appl. Rabbit Res.*, **14**:187-192.

Harvey, W.R. (1990). *User's guide for LSMLMW-PC2.* Version for Mixed Model Least-squares and Maximum Likelihood Computer program. Ames, Iowa College University, 90 pp.

Lebas, F. and Ouhayoun, J. (1987). Incidence du niveau protéique de l'aliment, du milieu d'élevage et de la saison sur la croissance et les qualités bouchéres du lapin. *Ann. Zootechn.*, **36**:421-432.

Lebas, F., Coudert, P., Rouvier, R. and de Rochambeau, H. (1986). The rabbit, husbandry, health and production. *FAO Animal Production and Health Series* No. 21, Rome, 235p.

NRC (1977). National Research Council. Nutrient Requirements of Domestic Animals. *Nutrient Requirements of Rabbits*. Nat. Acad. Sci., Washington DC., USA.

Ouhayoun, J. (1983). Growth and development of meat rabbits. *Cuni Sciences*, **1**:1-15.

Ouhayoun, J. and Cheriet, S. (1983). Valorisation comparée d'aliments à niveau protéiques differents, par des lapins séléctionnés sur la vitesse de croissance et par des lapins provenant de l'élevage traditionnels, I. Etude des performance de croissance et de la composition du gain de poids. *Ann. Zootechn.*, **32:**257-276.

Prud'Hon, M. (1976). Comportment alimentaire du lapin soumis à des température de 10°, 20° et 30° C. *Proc. I^ère Congr. Mond. Cuniculture*, Dijon, France, Communication n° 14.

Reyne, Y., Prud'Hon, M. and Angevain, J. (1978). Influence d'une réduction de la durée d'éclairement sur le comportement alimentaire du lapin en engraissement. *2^ème Journées de la Recherche Cunicole*, 4-5 Avril 1978, Toulouse, France, Communication n°7.

Varewych, H., Lampo, Dh., Bouquet, Y. and Van Zeveren, A. (1987). Erfelejkheidsorderzoek van karkaskwaliteit bij mestkonijnen. *Vlaams Diergeneeskundij Tijdschrift*, **56**: 348-358.

تقييم تركيب الذبيحة للأرانب النيوزيلندية البيضاء المرباه فى نظامين إيواء مختلفين

محمد رضا عانوس[1] ، محمد مسعد مراد[1] ، محمد صلاح عياط[2]

١- قسم الإنتاج الحيوانى ، كلية الزراعة جامعة عين شمس ، ص.ب ٦٨ حدائق شبرا ، رقم بريدى ١١٢٤١ القاهرة ، جمهورية مصر العربية

٢- قسم الإنتاج الحيوانى ، كلية الزراعة جامعة الزقازيق ، الزقازيق ، جمهورية مصر العربية

سجلت بيانات ١٠٢ من ذكور الأرانب مأخوذة من نسل ١٩ أب ، ١٠٢ أم من سلالة النيوزيلندى الأبيض تم تربيـــتها بمحافظة الشرقية فى نظامين إيواء مختلفين (النظام المفتوح بمزرعة كلية الزراعة جامعة الزقازيق و النظام المغلق بمزرعة شركة صان الحجر للأستثمار الزراعى والأمن الغذائى). ذبحت جميع الأرانب عندما وصلت إلى حوالى ٢ كجم وزن حى وذلك لتقييم تأثير نظام الإيواء على تركيب الذبيحة لهذه الأرانب وعلى إمكانية زيادة إنتاجها من اللحم من خلال الإنتخاب الفردى.

وقـــد أظهـــر تحليل التباين بطريقة المربعات الدنيا أن كلٍ من وزن الذبح ، وزن الذبيحة الساخنة ، محصول الدهن فى قطعيات القائمة الخلفية وبيت الكلاوى والمروحة ، محصول العظام فى قطعيتى القائمة الأمامية وبيت الكلاوى قد تأثرت معنوياً (عند مستوى ٥ % أو ١ %) بالاختلاف بين المزرعتين فى نظام الإيواء. هذه الاختلافات بين نظامى الإيواء فى صفات توزيع وزن الذبيحة على القطعيات المختلفة يمكن أن ترجع إلى الاختلافات فى ظروف الجو والرعاية بالمزرعـــتين. وعموماً فإن قيم المعالم الوراثية لهذه الصفات تظهر إمكانية تحسين تركيب الذبيحة فى الأرانب النيوزيلندية مـــن خـــلال الانتخاب المباشر لوزن الذبح. هذا الانتخاب أدى إلى زيادة محصول العضلات فى القائمة الخلفية بنسبة ٠،١٣ % وإلى نقـــص محصول الدهن فى قطعيتى بيت الكلاوى والمروحة بنسبة ٠،١٣ ، ٠،١٩ % على التوالى وإلى زيادة ملحوظة قدرها ٠،٢٧ % فى محصول العظام فى القائمة الأمامية.