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GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND CHEMICAL COMPOSITION OF NEW ZEALAND WHITE RABBITS AS AFFECTED BY AGE, SEX AND CARCASS CUT

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SUMMARY

This study was carried out on 36 New Zealand White rabbits in the Animal Production Department, Faculty of Agriculture, Cairo University. The rabbits were randomly divided into three equal groups to be slaughtered at 8, 10 and 12 weeks of age. Animals were weighed just before and after slaughtering. Hot carcass was broken-down into fore and hind limb and loin cuts. Dressing out percentage and proportion of meat and bone out of the carcass were determined. Meat samples from every carcass cut were obtained to determine moisture, protein, fat and ash content. To calculate change rate of the studied traits, the experimental period was divided into two periods, the first (P1) from 8 to 10 and the second (P2) from 10 to 12 weeks of age.

Growth rate in P1 was found to be higher than P2 by 9.3 %. Dressing percentage increased with age advance reaching 49.5 % at 12 weeks old .While boneless meat percentage was almost constant at the studied ages (91.7-92.2 %), However, meat percentage in carcass increased by 5.2 % from 8 to 12 weeks of age. This increase corresponded with a decrease in the other components of the body (- 8.2 %). Sex had no effect on all the studied traits during those four weeks of study. Hind limbs represented the major part of the carcass (38.2 %), while the loin represented the minor (27.8 %). Loin cut contained the highest percentage ($P<0.05$) of meat, while fore limbs had the least.

Neither age nor sex had significant effect on the chemical composition of rabbits' meat. Fat and protein changed positively with higher magnitude in P2 than P1. Chemical composition of meat differed in the carcass cut. Fore limbs had higher percentage ($P< 0.05$) of protein, while loin cut possessed higher percentage ($P< 0.05$) of fat and ash.

Keywords: NZW rabbits, age ,sex, carcass cut, growth performance, chemical analysis.

INTRODUCTION

Producing white meat at a large scale is adopted in Egypt to increase animal protein per capita. Rabbits are one of the alternatives to achieve this goal for their prolificacy (5-9 bunnies per litter; Khadr *et al.*,1996 and Saleh and Nofal, 1999), early sexual maturity (16-26 weeks; Sandford,1996) and high growth rate (28- 35 g per day till weaning; Ayyat and Anous,1995 and Khadr *et al.*,1996).

During the last two decades, New Zealand White (NZW) rabbits have been extensively raised in Egypt for their better growth rate, excellent meat type, and considerable flushing of loin and hind limb cuts at marketing age (two- three months, at body weight averaging 1.5- 2.5 Kg). Under the prevailing environmental conditions in Egypt, growth rate of NZW rabbits may be slowed down and consequently the carcass quality and economics of production may be negatively affected.

Meat quality could be the main factor that satisfies the consumers' need. It depends on chemical composition of meat that affects the nutritive value as well as meat taste. Genotype, age, weight, sex and type of feeding influence these two traits to a great extent.

In light of the previous facts, the present study was planned to investigate the effect of age and sex on carcass characteristics of NZW rabbits at the commonly marketing age, as reared under Egyptian condition.

MATERIALS AND METHODS

Animals and Management

This study was carried out at the Animal Physiology Laboratory, Faculty of Agriculture, Cairo University during the period from October 1998 to February 1999 on 36 New Zealand White rabbits (NZW). Bunnies were weaned at four weeks, and after weaning they were raised in a shaded room in wire hutches (five rabbits / hutch). Animals were group fed *ad. libitum* on commercial diet containing 16.4 % crude protein, 12.7% crude fiber, and 2540 kcal/kg metabolizable energy. Clean water was made available at will.

Growth parameters and carcass quality

After weaning animals were randomly assigned into three equal groups (n= 12). The first (G1, 7 males and 5 females) was slaughtered at eight weeks old, while those of the second (G2, 6 males and 6 females) and the third group (G3, 7 males and 5 females) were slaughtered at 10 and 12 weeks, respectively. Slaughter weight (SW) and hot carcass (HCW) were recorded just before and after slaughter. Heart, liver, kidneys, spleen, lungs with trachea, head and hide were directly obtained to determine their weights. Dressing out percentage (DP) was calculated as the ratio of HCW to SW.

Each carcass was sectioned into three cuts: fore and hind limbs and loin. Fore limb was separated at the level of the 12^{th} thoracic vertebrae. Splitting the trunk at the level of the 7^{th} lumber vertebrae gave loin and hind limbs cuts.

Each cut was weighed to calculate its proportion out of the carcass. Thereafter, meat

and bone were segregated to calculate their percentages out of each cut and the whole carcass. To calculate trend of changes in the studied traits, the experimental period was defined as two periods, the first (P1) from 8-10 and the second (P2) from 10 to 12 weeks.

Rate of growth and changes in body components (bone, meat, hide, head and other organs) between the studied age groups were calculated according to the following equations:

$$\text{Growth rate} = \frac{W_2 - W_1}{0.5\,(W_1 + W_2)} \times 100$$

$$\text{Rate of change} = \frac{W_{o1} - W_{o2}}{W_2 - W_1} \times 100$$

Where: W_1 was the initial age weight and W_2 was the final age weight.
W_{o1} & W_{02} are the initial and final weight of studied components, respectively relative to P1 and P2.

Chemical analyses

Meat samples from each carcass cut were obtained and weighed. Samples were ground to determine their chemical composition according to AOAC (1990). Moisture was determined by desiccating samples at 100-102° C in electric ovens. Protein and fat were determined in the dry samples using micro Kjeldahl and Soxlet methods, respectively. Ash was determined by burning the dry samples in a muffel at 550 °C

Statistical analyses

Analysis of variance using the General Linear Model was used to calculate the means of the studies traits using SAS (1990). The model contains age, sex and carcass cuts as fixed effects. All interactions between variances effects were found to be insignificant ($P \leq 0.05$).

$Y_{ijkl} = U + A_i + S_j + C_k + e_{ijkl}$

Where U is the mean
A_i = age, 1,2,3 (8,10 and 12 weeks)
S_j = sex, 1,2 (males and females)
C_k = carcass cuts, 1,2,3 (fore, and hind limbs and loin cuts)
e_{ijkl} = error

RESULTS

Growth and carcass characteristics

Daily gain was 14.3 g in P1 (8 to 10 weeks), vs. 27.3 g in P2 (10 to 12 weeks) that was nearly doubled in the second period. Advancement of age was accompanied by appreciable increase in all the carcass components. Dressing percentage increased with age progress from 42.5 % at 8 weeks to 49.3 % at 12 weeks of age, however,the

boneless meat percentage was almost similar in the three ages (91.7-92.2 %) (Table 1). Proportion of bone, hide and head out of the live body weight was almost constant in the three age groups, while, meat percentages increased by 5.2% from 8 to 12 weeks of age, and the other organs decreased by 8.2 % at 12 weeks old (Table 1 and Figure 1).

Table 1. Weight of body components (g) and carcass characteristics of NZW rabbits as affected by age and sex (LSM ± SE)

Trait	Age (wk)			Sex	
	8	10	12	Male	Females
Slaughter weight	1478.3±77^{a}	1677.5±76^{a}	2060.4±77^{b}	1718.3±59^{a}	1759.2±66^{a}
Carcass weight	633.6± 48^{a}	803.3 ± 47^{b}	1020.0±48^{c}	814.1± 37^{a}	823.9± 41^{a}
Meat weight	582.9±44.5^{a}	736.9±43.9^{b}	940.2±44.5^{c}	747.4±34.1^{a}	759.2±38.1^{a}
Bone weight	50.7 ± 3.9^{a}	66.5 ± 3.8^{b}	79.8 ± 3.9^{c}	66.6 ± 3.0^{a}	64.7 ± 3.3^{a}
Edible organs	80.2± 3.5^{ab}	73.3 ± 3.4^{b}	86.9 ± 3.5^{a}	79.3 ± 2.6^{a}	81.0± 2.9^{a}
Head weight	130.1±6.2^{a}	156.7± 1.6^{b}	181.7± 6.2^{c}	160.1±4.8^{a}	152.2± 5.3^{a}
Skin weight	160.0±12.8^{a}	174.2±12.6^{a}	230.4±12.8^{b}	186.5±9.8^{a}	189.9±10.9^{a}
Dressing (%)	42.5^{a}	46.7^{b}	49.3^{b}	46.5^{a}	46.4^{a}
Boneless meat (%)	92.0^{a}	91.6^{a}	92.2^{a}	91.7^{a}	92.2^{a}

Number of animals in age groups was 12 and in sex groups was 20 males and 16 females.
^{a,b,c} Means in each row, within age or sex groups, having different superscripts are significantly different (P<0.05)

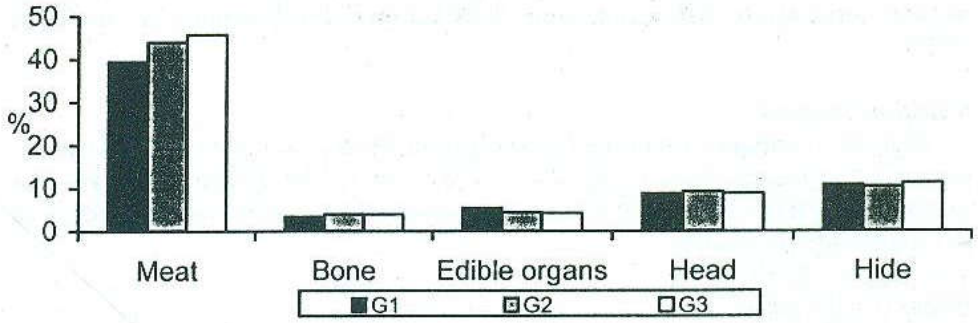

Figure 1: Percentage of body components of New Zealand White rabbits as affected by age (G1, G2 and G3 for 8, 10, and 12 weeks old, respectively).

Changing rate in slaughter weight during the second period of the experiment (P2) was found to be higher than that in the first one (P1) by about 7.9 %. On the contrary, changing rate in dressing percentage during P1 was higher than P2 by 4.0 %. Change in HCW out of SW was almost equal in the two periods (Figure 2).

Rate of growth in bone, head and meat decreased with age progress, while rate of change in hide showed a reverse trend (Figure 3). It is interesting to note that rate of decrease in meat was the highest (-27.0 %), followed by head (- 6.5 %) and bone (-4.2 %). Meanwhile, rate of increase in hide was higher by +7.4 %, respectively.

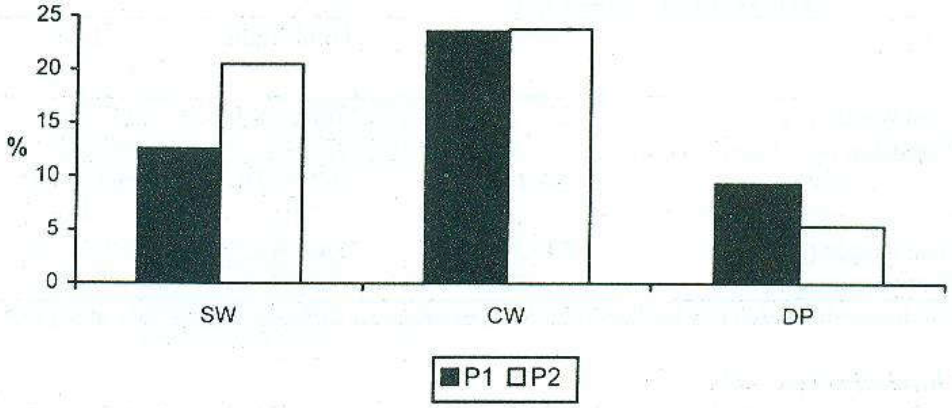

Figure 2. Rate of change (%) in slaughter weight (SW), carcass weight (CW) and dressing percentage (DP) as the difference of periods, (P1) 8-10 weeks, and (P2) 10-12 weeks

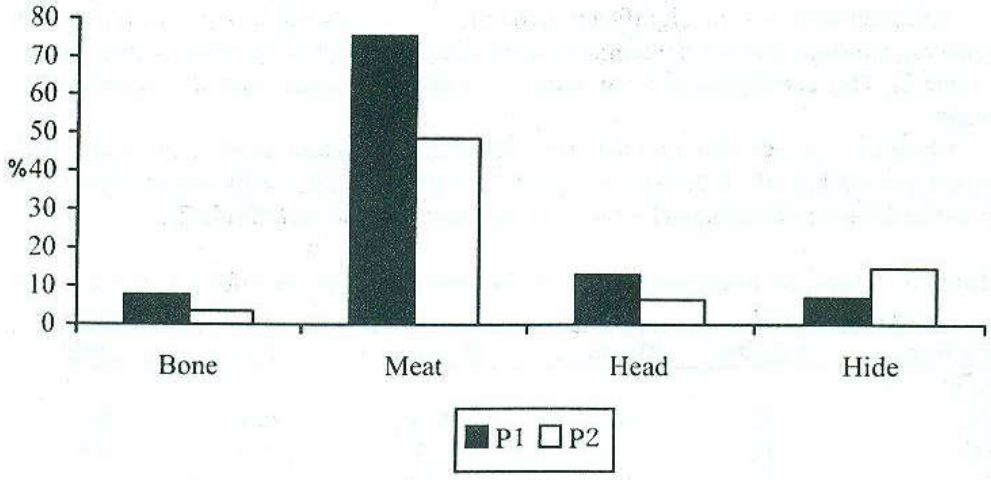

Figure 3. Percentage of increase in body components of New Zealand White rabbits in the two periods (P1 and P2) of study

Sex had no effect on all the studied traits up to12 weeks of age. Weight of all body compartments was slightly higher in females than males except head and bone (Table 1). At 12 weeks of age, dressing and boneless meat percentages in both sexes were almost equal.

The overall mean of carcass weight regardless age was 818.6 $\pm$ 27.4 g. The hind limbs represented the major part of the carcass (38.2 %), while loin represented the minor (27.8 %) (Table 2). On the other hand, loin contained the highest percentage ($P<0.05$) of meat, while the fore limbs contained the least.

Table 2. Carcass components (LSM ± SE) of NZW rabbits as affected by carcass cut (n= 36 per cut)

Trait	Fore limbs	Hind limbs	Loin
Total weight (g)	277.1 ± 9.3 [a]	312.9 ± 8.9 [b]	226.6 ± 8.9 [c]
Proportion out of carcass (%)	33.9	38.2	27.7
Bone weight (g)	30.4 ± 0.9 [a]	26.1 ± 0.9 [b]	9.2 ± 0.9 [c]
Bone percentage (%)	11.0	8.3	4.0
Meat weight (g)	246.8 ± 8.3 [a]	286.8 ± 8.3 [b]	217.5 ± 8.3 [c]
Meat percentage (%)	89.0 [a]	91.7 [b]	96.0 [c]

[a,b,c.] Means within each row having different superscripts are different significantly at 5% level

Chemical composition

Age had no effect on the chemical composition of rabbits' meat at the studied ages (Table 3). However, moisture and protein percentages showed a descending trend with age progress, dry matter and fat percentages increased in ascending trend. Ash percentage was almost constant.

Rate of fat change between ages was positive in P1 and P2 with higher magnitude in P2 (about three times). Protein percentage in P2 was higher than in P1, while an opposite trend was observed concerning water content (Figure 4).

Although there was no significant difference in carcass composition of males and females, moisture and fat percentages were relatively higher in females than males (Table 2). This corresponded by an increase in protein and dry matter percentages in males.

Chemical composition of meat was affected by carcass cuts. Fore limbs had higher percentage ($P< 0.05$) of dry matter and protein. On the other hand, loin cut possessed higher percentage ($P< 0.05$) of moisture, fat and ash (Table 2).

Table 3. Chemical analyses (%) of NZW rabbits meat as affected by age, sex and carcass cut

Factors	Number	Moisture	Protein[1]	Fat[1]	Ash[1]
Age[2]					
G1	12	74.6 [a]	69.8 [a]	25.0 [a]	4.5 [a]
G2	12	73.8 [b]	69.2 [a]	25.1 [a]	4.5 [a]
G3	12	72.7 [c]	69.3 [a]	25.4 [a]	4.6 [a]
Sex					
Male	20	73.5 [a]	69.6 [a]	25.0 [a]	4.5 [a]
Female	16	73.9 [a]	69.3 [a]	25.4 [a]	4.6 [a]
Cuts					
Fore Limb	36	72.2[a]	71.9[a]	24.3[a]	4.5[a]
Hind Limb	36	74.8[b]	69.2[b]	24.1[a]	4.4[a]
Loin	36	74.1[c]	67.2[c]	27.3[b]	4.8[b]

[a,b,c.] Means within each column having different superscripts are different significantly at 5%

1- % Chemical composition was calculated on dry matter basis

2- Slaughter age was 8, 10 and 12 weeks for G1, G2 and G3, respectively

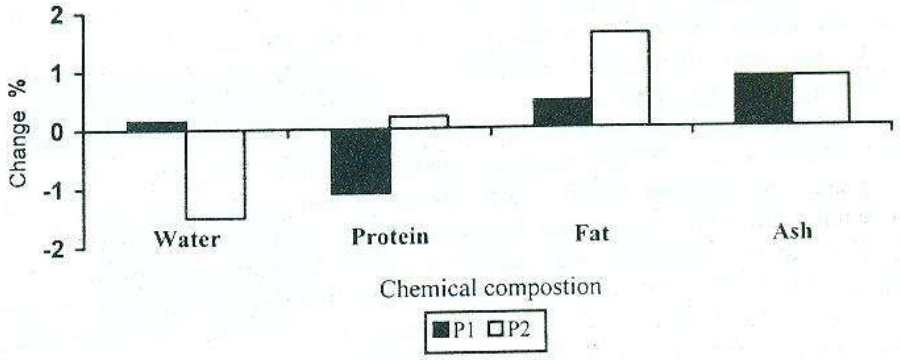

Figure 4. Change in the percentage of chemical composition of the rabbits' meat with age progress as the difference between P1 (8 to 10 weeks) and P2 (10 to 12 weeks)

DISCUSSION

Slaughter weight obtained in this study at 8 weeks of age (1478 g, Table 1) is close to those reported previously on NZW rabbits in Egypt by Hilmy (1991) and Khadr *et al.* (1996) (1464 - 1504 g). However, it is lower than that reported by Afifi *et al.* (1998; 2842 g) at the same age. At 12 weeks, El-Sayaad *et al.* (1996) reported lower weight of NZW rabbits (1169-1909 g) than that obtained in the present study (2060 g).

Increasing dressing and boneless meat percentages with age progress agrees with that recorded by Lukefaur *et al.* (1985). This is due to a) faster increase of meat in the carcass, b) slower development of the other body organs, and c) stability of bone, head and hide calculated as percentages (Figure 2).

High rate of change in body weight in P2 than P1 (Figure 2) indicated that rabbits at that age are still in the exponential phase of growth curve. Decrease of dressing percentage in P2 compared to P1 (Figure 2) is most probably due to high rate of change in both hide and body organs (about 29.5%).

The similar growth performance, carcass characteristics and chemical analysis obtained in both sexes (Tables 1&3) is close to the reports of Ristic *et al.* (1990), Parigi-Bini *et al.* (1992) and Battaglini *et al.* (1995) indicating no difference in growth rate due to sex in early age stages. This is mainly due to that rabbits between 8 and 12 weeks of age were still far from pre-pubertal stage, with delay in sex hormones secretion. In older ages, males have better growth rate than females (Ristic, 1989), due to secretion of androgen which enhances growth pattern of muscles and bones (Lawrence and Fowler, 1998).

Changes in chemical components in rabbits' meat (Figure 4) indicated that water percentage decreased in P2 than P1, which agrees with the findings of Soliman (1994) , El-Gammal *et al.* (1984) and Bieniek *et al.* (1994). No elucidation could be provided to explain the trend of change in protein percentage in P1. It is well known that there is a positive correlation between protein and water content in meat,

opposite to fat, which did not exist, in the present study. This unexpected finding may be attributed to young age under investigation. Protein percentage in the previous studies showed contradictory trends. While, Bieniek *et al.* (1994) reported higher protein in older ages, El-Gammal *et al.* (1984) reported no change for protein percentage with age progress.

Increase in fat percentage with age progress agrees with El-Gammal *et al.* (1984) and Bieniek *et al.* (1994) reporting tendency of more fat deposition with age progress. The constant trend in ash change is mainly attributed to homeostasis function of the body to keep body fluids osmolality stable.

It could be concluded that marketing age of New Zealand White rabbits is preferred to be between 10 and 12 weeks of age during which the daily increase in weight is faster. Rabbits at that age have better carcass weight and higher dressing and meat percentages as well as better nutritional value. Moreover, both sexes could be marketed with the same price due to their similar carcass characteristics and chemical composition of meat. At marketing of pre-prepared carcass, loin and hind limb could be classified as first quality cuts. This is because of their higher percentage of meat compared to fore limbs.

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REFERENCES

Afifi, E. A., A.M. Abdel-Ghany, E.G. Ahmed and M. S. Khattab, 1998. Litter weight and mean bunny weight per litter in two standard breeds of rabbits raised in adverse environments. Egyptian J. Anim. Prod., Vol. 35 (Supplement Issue): 345- 357

Association of Official Analytical Chemists (AOAC), 1990. *Official Methods of Analysis*, 15th Edition. The Association of Official Analytical Chemists, Arlington, Virginia, USA

Ayyat, M.S. and M. R.Anous, 1995. Magnitude and direction of genetic-environmental interaction in rabbits with special reference to live and slaughter performance and carcass cut- out. World Rabbit Science , 3 (1): 3-8

Bieniek, J.; D. Dorozynska; Z. Stalinski and T. Kolczak, 1994. Studies on rabbit meat production. II. Effect of age on meat quality. Prace i Materialy Zootechniczne, 46 : 65-73

Battaglini, M.B.; C. Castellini; P. Lattaioli and B.B. Marce, 1995. Effect of sire strain, feeding, age and sex on rabbit carcass. World Rabbit Science, 3 (1): 9-14.

El-Gammal, A.M., M.N. Makled and M.A. Abdel-Naby, 1984. Chemical composition of rabbit meat as affected by age, sex and carcass cuts. Indian J. of Anim. Sci., 54 (3): 227-229

El- Sayaad, G.A.E., H. Taie and G. A. Baraghit, 1996. Effect of dietary crude fiber levels on performance, digestibility, carcass quality and blood constituents of growing rabbits. Egyptian J. Anim. Prod., 33 (2), 111-123.

Hilmy, A. F. 1991. Some productive aspects in rabbits. M. Sc. Thesis, Fac. Agric., Moshtohar, Zagazig Univ., Egypt.

Khadr, Amina F., Nagwa A. Ahmed and A. A. Azoz, 1996. Effect of post - partum mating interval on reproductive and productive performance of rabbits. Egyptian J. Anim. Prod., Vol. 33 (Supplement Issue): 389-401.

Lawrence, T.L.J. and V.R. Fowler, 1998. *Growth of Farm Animals.* 2nd Edition. CAB International, UK.

Lukefahr, S., W.D. Hohenboken, P.R. Cheeke and N.M. Patton, 1983. Appraisal of nine genetic groups of rabbits for carcass and lean yield traits. J. of Anim. Sci., 4: 899-907.

Parigi-Bini, R.; G. Xiccato; M. Cinetto and A. Dalle- Zotte, 1992. Effect of slaughter age and weight on carcass and meat quality of the commercial rabbit. J. of Applied Rabbit Research, 15: 819- 826.

Ristic, M., 1989. Effect of sex and final fattening weight on carcass value of young rabbits. Arbeitstagung ubar Pelztiere, Kaninchen und Heimtiere Produktion und Krankheiten, 81-88. Cited by Animal Breeding Abstracts (1990): 58

Ristic, M.; D. Krogmeier and V. Dzapo , 1990. Carcass quality in New Zealand White and Silver young rabbits and their F1 crosses. Arbeitstagung ubar Haltung und Krankheiten der Kaninchen, Pelztiere und Heimtiere, 164-190. Cited by Animal Breeding Abstracts (1992).

Saleh, K. and R. Y. Nofal, 1999. Effect of Grey Flander, New Zealand and Baladi as sire breeds on pre- and post weaning litter traits in Rabbits. Egyptian J. of Anim. Prod., 36 (2): 121-130.

Sandford, J.C., 1996. *The Domestic Rabbit.* 5th Edition. Blackwell Science.

SAS , 1990. Statistical Analysis Systems Institute, SAS/ STAT user's guide, version 6. Inc., Cary, NC.

تأثيـــر العمر و الجنس و القطعية على مظهر النمو، خصائص الذبيحة و التركيب الكيميائى للحم فى أرانب النيوزلندى الأبيض

آمال كمال العشيرى

قسم الإنتاج الحيوانى- كلية الزراعة - جامعة القاهرة - الجيزة - ج.م.ع

أجريت هذه الدراسة فى كلية الزراعة - جامعة القاهرة على ٣٦ أرنب من نوع النيوزلندى الأبيض (٢٠ ذكر، ١٦ أنثى)، تم تقسيمهم إلى ثلاث مجاميع متساوية العدد (١٢ حيوان/ مجموعة) تبعاً لعمر الذبح على ٨، ١٠، ١٢ أسبوع على التوالى. تم وزن الحيوانات قبل وبعد الذبح مباشرة .ثم قُسمت الذبيحة الدافئة إلى أرباع أمامية و أرباع خلفية و جذع. وتم تقدير نسبة التصافى و نسبة اللحم و العظام. تم الحصول على عينة من اللحم ممثلة لكل قسم من أقسام الذبيحة لتقدير النسبة المئوية لمكونات اللحم الكيميائية: الرطوبة، البروتين، الدهن، الرماد. قسمت فترة التجربة إلى قسمين لحساب معدل التغير فى الصفات المدروسة. الفترة الأولى من عمر ٨ــ١٠ أسابيع و الثانية من عمر ١٠- ١٢ أسبوع.

وجـد أن معـدل النمو خلال الفترة الأولى أعلى منه فى الفترة الثانية بحوالى ٩,٣ %، وكانت نسبة التصـــافى تزيد مع تقدم العمر ووصلت ٤٩,٥ % على عمر ١٢ أسبوع، بينما كانت نسبة اللحم الخالى من العظـــام ثابتة فى كلتا الفترتين (٩١,٧- ٩٢,٢ %). زادت نسبة اللحم فى الذبيحة بمقدار ٥,٢ % مع تقدم العمـــر من ٨-١٢ أسبوع و أرتبطت هذه الزيادة بانخفاض مكونات الجسم الأخرى بمقدار (٨,٢ %). وقد وجد أن جنس الحيوان لم يكن له أى تأثير معنوى على كل الصفات المدروسة خلال فترة الدراسة.

وقـد وجد أن الأرباع الخلفية تشكل النسبة الأكبر من مكونات الذبيحة (٣٨,٢%) ويشكل الجذع النسبة الأدنى (٢٧,٨%)، إحتوت الأرباع الخلفية على أكبر نسبة من اللحم بينما كانت الأرباع الأمامية هى الأقل.

ولم يكن للعمر و الجنس تأثير معنوى على التركيب الكيماوى للحم الأرانب، وإن كان التركيب يختلف من قطعية لأخرى فى الذبيحة حيث إحتوت الأرباع الأمامية على أعلى نسبة بروتين أما الجذع فإحتوى على أعلى نسبة دهن ورماد.