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CONSEQUENCES OF SELECTION FOR POST-WEANING GROWTH PERFORMANCE ON CARCASS ATTRIBUTES IN RABBITS

G.F. Gouda and Shemeis, A.R.
Animal Production Department, Faculty of Agriculture, Ain Shams University, Shoubra El-Kheima, 11241 Cairo, Egypt.
Corresponding Email : *gfgouda@agr.asu.edu.eg & gouda_fathi@yahoo.com*

ABSTRACT

The aim of this work is to investigate the consequences of selection for post-weaning growth performance on carcass composition and carcass meatiness traits. Seven selection indices were applied using estimates of genetic and phenotypic parameters on 218 New Zealand White (NZW) rabbits, progeny of 24 bucks and 93 does, via a multi-trait animal model. Weaning weight (WW), Slaughter weight (SW) and daily gain between them (DG) were used as sources of information. The breeding objective was to enhance the profitability of NZW rabbit breeders by maximizing WW, SW, and DG. The carcass composition was represented as the percentage of dissected side weight deposited as muscle (MP), Fat (FP), and bone (BP), while carcass meatiness traits were represented as carcass weight (CW), dressing percentage (DP), muscle: bone ratio (MB), and muscle: fat ratio (MF). The heritability estimates (h^2) were 0.69, 0.44 and 0.54 for WW, SW and DG, respectively. Carcass composition traits showed moderate estimates of h^2 for MP (0.31) and FP (0.35) and a very high value for BP (0.91). The h^2-values for carcass meatiness traits were 0.42, 0.43, 0.89, and 0.75 for CW, DP, MB, and MF, respectively. The full index (I_1): I_1 = 6.39 WW - 1.85 SW + 150.92 DG had the highest correlation with the aggregate genotype (r_{TI} = 0.81), followed by the best reduced index involving WW and DG (r_{TI} = 0.79): I_3 = 4.21 WW + 71.74 DG.

However, the single trait selection index based on WW alone (I_5 = 4.46 WW) is expected to be as efficient as the best reduced index (r_{TI} = 0.76).

At each round of selection with the intensity of selection = 1.0, applying of I_1, I_3 and I_5 are expected to result in developing NZW rabbits with better post-weaning growth performance in terms of heavier body weight at weaning (ranged from 112.93 to 121.35 gm) and slaughtering (ranged from 124.70 to 135.52 gm) with faster daily gain (ranged from 0.32 to 0.78 gm/day). This enhancement in post-weaning growth performance is expected to consequence in an increase in MP (ranged from 0.67 to 0.82 unit) and FP (ranged from 0.31 to 0.59 unit) and reduction in BP (ranged *from -0.43 to -0.31 unit). Carcass meatiness traits are expected to be more favorable in terms of higher DP (ranged from 0.14 to 0.38 unit) and MB ratio (ranged from 0.28 to 0.36 unit) and less favorable in terms of MF (ranged from -0.23 to -1.60 unit).*

***Conclusively,** the results obtained in the present study suggested that selection based on the single trait index I_5 including the weaning weight trait would be recommended to improve the given aggregate genotype traits for being an early, single, and easy-to-measure.*
***Keywords:** Rabbits – Selection indices – Post-weaning growth traits – Carcass composition – carcass meatiness traits.*

INTRODUCTION

In a previous study on consequences of selection for post-weaning growth performance traits on fat partition traits in rabbits (Gouda, 2022), it was obvious that selection for post-weaning growth in terms of heavy body weight at weaning and slaughtering and faster gain from weaning to slaughter is expected to develop New Zealand White (NZW) rabbits with unfavorable fat partitioning in terms of higher fat content deposited as subcutaneous, mesenteric, caul, and heart fat with lower intermuscular and kidney knob fat. Still some attendant aspects seem worthwhile, in particular with regard to carcass composition and carcass meatiness traits.

Several studies showed the effect of body weight on carcass characteristics (Belabbas *et al*, 2019; Michalik *et al.*, 2009; Pascual *et al.*, 2008 and Piles *et al*., 2000) but scarce numbers of studies related to estimate of genetic parameters for carcass composition and carcass meatiness traits (Blasco *et al*., 2018) were noticed.

From these points of view, the present study was undertaken to investigate the expected effect of selection for growth performance traits on carcass attributes in rabbits.

MATERIALS AND METHODS

Source of data and animal management

This study was applied during 2004-2005 in a private rabbit farm located in Qalyobia Governorate, 25 km far from Cairo, where 218 rabbits of NZW rabbits, progeny of 24 bucks and 93 mature does, were randomly chosen at weaning on 28 days. Rabbits were weighed after they separated from their dams (WW), housed in fattening batteries, and reared under natural environmental circumstances, and fed *ad libitum* a commercial diet offering 2800 kcal digestible energy/kg diet up to slaughter on 90 days.

Traits considered

By the end of the fattening period at 90 days of age, rabbits are weighted before slaughtering (SW) and daily gain from weaning up to slaughter (DG) was determined. The animals were transported from the farm to the Meat Laboratory of Ain Shams University, Egypt. In Meat Laboratory, rabbits were slaughtered and dressed out according to Blasco *et al.* (1993) where the carcasses were weighted, and dressing percentages were calculated. Then, the carcasses were split into two halves. The right half was dissected into muscle, fat (intermuscular plus subcutaneous), and bones. The total dissected weight was calculated by the sum weight of muscle, fat, and bone where carcass composition, muscle to fat ratio, and muscle to bone ratio were calculated.

Statistical analysis

Depending on VCE-6 software package (Kovač *et al*., 2002), the data was analyzed and the genetic and phenotypic parameters were estimated according to the following Multi-trait animal model:

$$y = Xb + Za + e$$

Where:

y = is the observations traits vector,
b = is the fixed effects vector (year of birth),
a = is the random additive genetic direct effects vector,
X and Z = known incidence matrices relating observations to the respective fixed and random effects with Z augmented with columns of zeros for animals without records, and
e = is the random residual effects vector.

Definition of aggregate genotype traits

The breeding objective of the present study was to increase the net profit of rabbit breeders via selection for higher growth performance traits from weaning up to slaughter including slaughter weight (SW), weaning weight (WW), and daily gain between them (DG). The aggregate genotype (T) was defined as:

$$T = a_1\, g_{WW} + a_2\, g_{SW} + a_3\, g_{DG},$$

Where:

g_{ww} = The additive genetic value of weaning weight
g_{SW} = The additive genetic value of slaughter weight,
g_{DG} = The additive genetic value for daily gain from weaning up to slaughter, and
a_1, a_2, a_3 = The relative economic weights for WW, SW and DG, respectively.

Economic values of aggregate genotype traits

Depending on heritability estimates, the method described by Lamont (1991) was used to compute the economic values (a) of WW, SW, and DG as follow:

$$a_i = \frac{\sum_i^n h_i^2}{h_i^2}$$, Where

h_i^2: The heritability estimates of the ith trait included in the aggregate genotype.

Selection indexes

To achieve the breeding objective of the present study, seven selection indices with different combinations from WW, SW and DG were applied according to Hazel *et al*. (1994). The indices combinations were applied under three alternatives categories as follows:

i: selection based on a full index comprising all sources of information.

ii: selection based on reduced indices, comprising the combination of one source of information with the other; and

iii: selection based on a single source of information.

RESULTS AND DISCUSSION

Variability and heritability

Table (1) presented overall means, heritability estimates, phenotypic coefficient of variations and economic values of considered traits. Comparable phenotypic variabilities were found for the growth performance traits (WW, 24.40%; SW, 16.90%; DG, 20.60%). These variabilities were much higher than those of carcass composition and carcass meatiness traits (1.90 : 11.7%), with the exception of the two measures involving fat content (FP, 36.27% and MF ratio, 46.98%). Comparable trend of variability was reported in previous studies (Peiró *et al*., 2021; Ezzeroug *et al*., 2020; Peiro´ *et al*., 2019, Sakthivel *et al*., 2017; Dige *et al*., 2012; Iraqi, 2008; Shemeis and Abdallah, 2000).

The values of h^2 estimates for WW, SW, and DG had a higher magnitude, (0.69, 0.44, and 0.54, respectively). These higher heritability estimates indicate the possibility of improving these traits through direct selection. The estimate obtained for WW in the present study is much higher than those found in the literature (0.15, Peiró *et al*., 2021; 0.26, Montes-Vergara *et al*., 2021, 0.03, Ezzeroug *et al*., 2020; 0.09, Sakthivel *et al*., 2017; 0.04, Drouilhet *et al*., 2013; 0.04, Lukefahr, 1996). Similarly, the present h^2 estimates for SW and DG were higher than those previously stated in the

Table 1. Overall means ($\bar{x} \pm SE$), phenotypic variation coefficients (CV%), heritability estimates (h^2±SE) and calculated economic values (a) of post- weaning growth traits and carcass attributes

Trait	$\bar{x}$ ±SE	CV%	h^2±SE	a
i. *Post-weaning growth traits*				
• Weaning weight, gm (WW)	406.15 ± 6.72	24.40	0.69 ± 0.02	2.42
• Slaughter weight, gm (SW)	1746.81 ± 20.10	16.90	0.44 ± 0.03	3.80
• Daily gain, gm/day (DG)	21.28 ± 0.29	20.60	0.54 ± 0.04	3.09
ii. *Carcass attributes*				
1. Carcass composition traits				
• Muscle percentage (MP)	83.64 ± 0.10	1.90	0.31 ± 0.01	-
• Fat percentage (FP)	3.97 ± 0.09	36.27	0.35 ± 0.02	-
• Bone percentage (BP)	12.38 ± 0.09	11.14	0.91 ± 0.04	
2. Carcass meatiness traits				
• Carcass weight (CW)	903.04 ±11.40	8.64	0.42 ± 0.03	-
• Dressing percentage (DP)	51.60 ± 0.19	5.52	0.43 ± 0.04	-
• Muscle: bone (MB)	6.83 ± 0.05	11.71	0.89 ± 0.01	-
• Muscle: fat (MF)	24.69 ± 0.78	46.98	0.75 ± 0.02	-

literature (Montes-Vergara *et al.,* 2021; Peiró *et al.,* 2021; Sakthivel *et al*., 2017; Dige *et al.*, 2012; Garreau *et al*., 2008; Moura *et al*., 2001).

The h^2-estimates for carcass compositional traits indicated that the percentage of carcass weight deposited as bone (BP) was more heritable (0.91) than that deposited as muscle (MP = 0.31) or fat (FP = 0.35). Moderate heritability estimates (0.29 - 0.39) for compositional traits were recorded in previous studies (Al-Saef *et al.,* 2008; Shemeis and Abdallah, 2000; Ferraz *et al.,* 1991 & 1992).

The estimates of heritability for carcass meatiness traits being 0.42 for CW, 0.43 for DP, 0.89 for MB and 0.75 MF. However, the present estimate of h^2 for CW is higher than the estimates reported previously (Montes-Vergara, 2021 and Nagy *et al.,* 2019). In agreement with the literature (Garreau *et al.,* 2008 and Larzul, *et al.,* 2005), the dressing percentage was shows to be moderates heritable. However, low heritability estimates were cited (0.19 and 0.17) for DP by Shemeis and Abdallah (2000) and Su *et al*. (1999), respectively.

The variation observed in the heritability estimates, which are given in the literature and what is given in the present work, clarifies the effect of genetic and environmental factors, the model applied in analysis, the number of considered traits and the genetic relationship between them. Garcia and Argente (2020) likewise illustrated that the population size, the managements in each farm, the mother's productive capacity, the marketing body weight, the growth rate, the degree of maturity at slaughter, the ages at slaughter and weaning, and the models used in the analysis are possible factors explain the differences in heritability estimates between studies.

Genetic and phenotypic Correlations

Genetic (r_G) and phenotypic (r_P) correlations among the traits describing post-weaning growth, carcass composition, and carcass meatiness are shown in Table 2. Rabbits which weaned at heavier weight are expected to be heavier at slaughter (r_G=+0.81; r_P =+0.82). The faster-gaining rabbits from weaning to slaughter are expected to produce carcasses with better composition in terms of dressing percentage (r_G = + 0.24; r_P = +0.31) and bone percentage (r_G= -0.58; r_P = - 0.54).

Genetically, rabbits with heavier body weight at weaning and slaughter with faster daily gain would expect to yield carcasses with lower bone percentage (r_G=-0.36, -0.60 and -0.58, respectively), muscle percentage (r_G= -0.23, -0.35 and -0.05, respectively) with negligible change in MB ratio (r_G= -0.01, -0.01 and -0.03, respectively). Moreover, these rabbits would be higher in carcass weight (r_G= +0.50, +0.83 and +0.38, respectively) with an improvement in dressing percentage (r_G =+0.10, +0.11 and +0.24, respectively) and muscle to bone ratio (r_G= +0.09, +0.15 and +0.13, respectively). The same trend of associations was previously reported for carcass weight with weaning weight (Montes-Vergara, 2021) and with slaughter weight (Rotimi *et al*., 2021; Montes-Vergara *et al.*, 2021; Montes-Vergara *et al.*, 2020 and Sam *et al.*, 2020).

Positive genetic inter-relationships were noticed in present study among carcass compositional traits (r_G = 0.05 to 0.47). However, these traits were negatively correlated with the carcass weight deposited as MP (r_G = - 0.47), FP (r_G = - 0.20) and BP (r_G = - 0.45). Except for the genetic correlation between MB and MF ratios (r_G = -0.92), negligible genetic and phenotypic correlations were observed among meatiness traits.

Dressing percentage is genetically correlated positively with muscle and fat percentage (r_G = 0.38 and 0.29, respectively) and negatively correlated with bone percentage (r_G= - 0.45).

Indices

Seven selection indices were constructed using the calculated economic values and the estimates of genetic and phenotypic (co) variances. Table 3

Table 2. Genetic (above diagonal) and phenotypic (below) correlations for post-weaning growth traits and carcass attributes

Trait	i. Post-weaning growth traits			ii. Carcass attributes						
				1. Carcass compositi traits			2. Carcass meatiness Traits			
	WW	SW	DG	MP	FP	BP	CW	DP	MB	MF
i. *Post-weaning growth traits*										
• Weaning weight, gm (WW)	-	0.81	0.18	-0.23	0.08	-0.36	0.50	0.10	0.09	-0.01
• Slaughter weight, gm (SW)	0.82	-	0.59	-0.35	0.04	-0.60	0.83	0.11	0.15	-0.01
• Daily gain, gm /day (DG)	0.20	0.60	-	-0.05	0.26	-0.58	0.38	0.24	0.13	-0.03
ii. *Carcass attributes*										
1. Carcass composition traits										
• Muscle percentage (MP)	0.01	0.12	0.23	-	0.47	0.05	-0.47	0.38	-0.03	0.03
• Fat percentage (FP)	0.16	0.31	0.50	0.56	-	0.24	-0.20	0.29	-0.16	-0.03
• Bone percentage (BP)	-0.33	-0.47	-0.54	-0.09	-0.04	-	-0.45	-0.45	-0.33	0.02
2. Carcass meatiness traits										
• Carcass weight (CW)	0.47	0.83	0.63	0.10	0.29	-0.38	-	-0.13	0.12	-0.01
• Dressing Percentage (DP)	0.17	0.21	0.31	0.09	0.48	-0.49	0.09	-	0.14	-0.01
• Muscle: bone (MB)	0.09	0.16	0.20	0.16	0.10	-0.36	0.16	0.23	-	-0.92
• Muscle: Fat (MF)	-0.01	-0.02	-0.04	-0.02	-0.13	0.02	-0.02	-0.02	-0.02	-

showed the weighing factors, the accuracy of selection, and standard deviation of indices with the relative efficiency of each index to the full index. Including all sources of information, the full index gives the highest selection accuracy (I_1: r_{TI} = 0.81) in improving post-weaning traits due to its favorable inter-correlation (Table 2). In terms of accuracy, the alternative reduced index (I_3) including WW and DG traits was found to be the best-reduced index as compared to the full index (I_3: r_{TI} = 0.79 and RE = 97.5%). On the other hand, using the reduced index including SW with DG (I_4) or WW (I_2) would decrease the accuracy of selection by 19.8% and 11.1%, respectively, as compared to the full index.

In the present study, the single trait index (I_5) including WW, which is an earlier measurable trait, would be the best single index in improving post-weaning traits (I_5: r_{TI} = 0.76 and RE= 93.8%). The higher genetic correlation between WW and SW (0.81) and between SW and DG (0.59) plays an important role in this response of selection depending on WW alone.

In selection programs, post-weaning daily gain from weaning to slaughtering is the most common direct criteria (Garcia and Argente, 2020). El-Deghadi and Ibrahim (2018) developed selection indices to improve post-weaning growth performance in the Gabali rabbit breed using body weights at different ages and recommended an index including body weights at 6 and 8 weeks of age to enhance post weaning growth traits. However, in other studies, Hanaa *et al*. (2014) and Anous (2001) recommended that a selection index based on body weight at marketing or slaughter is better than weaning weight and daily gain in improving post-weaning growth traits.

In present study, and from the commercial point of view, selection based on a single index (I_5) including weaning weight trait could be considered the best index to achieve the objective of the study in improving post-weaning growth traits in New Zealand rabbits. This is because this trait is early, single, and easy to measure and can save the fatting cost in case of applying early selection.

Expected genetic change

The expected genetic change per generation to selection for post-weaning growth traits on carcass attributes are presented in Table 4 as absolute values and in Figure 1 as a percentage of the overall mean for the same trait.

i. ***Post-weaning growth traits.***

The highest expected genetic response per generation in aggregate genotype traits would be occur in the case of applying the full index (I_1) including all sources of information by 121.35gm in weaning weight,

Table 3. Weighing factors, indices standard deviation (σ_I), accuracy of selection (r_{TI}) estimated from each index (I) and relative efficiency (RE) to the full index (I_1 =100)

Selection alternatives	Index I	Index trait	Weighing factors* WW	SW	DG	σ_I	r_{TI}	RE%
i. *Full index*	I_1	WW, SW, DG	6.39	-1.85	150.92	809.7	0.81	100
ii. *Reduced index*	I_2	WW, SW	4.07	0.29	-	761.78	0.72	88.9
	I_3	WW, DG	4.21	-	71.74	788.41	0.79	97.5
	I_4	SW, DG	-	2.46	-18.71	650.41	0.65	80.2
iii. *Single index*	I_5	WW	4.46	-	-	760.32	0.76	93.8
	I_6	SW	-	2.34	-	648.90	0.65	80.2
	I_7	DG	-	-	119.95	355.83	0.35	43.2

*: WW= Weaning weight; SW= Slaughter weight, DG= Daily gain

Table 4. Expected genetic change to selection per generation for post-weaning growth traits and carcass attributes (selection intensity= 1)

Trait	Unit	Selection alternatives						
		Full index	**Reduced index**			**Single index**		
		I_1	I_2	I_3	I_4	I_5	I_6	I_7
		WW, SW, DG	WW, SW	WW, DG	SW, DG	WW	SW	DG
i. *Post-weaning growth traits*								
• Weaning weight (WW)	gm	121.35	116.06	112.93	78.83	118.46	76.66	18.74
• Slaughter weight (SW)	gm	135.52	126.57	135.31	120.65	124.70	121.55	80.60
• Daily gain (DG)	gm/day	0.78	0.39	0.73	0.76	0.32	0.86	1.61
ii. *Carcass attributes*								
1. Carcass composition traits								
• Muscle percentage (MP)	unit	0.67	0.79	0.82	0.99	0.75	0.99	0.50
• Fat percentage (FP)	unit	0.59	0.31	0.44	0.21	0.31	0.24	0.60
• Bone percentage (BP)	unit	-0.31	-0.45	-0.42	-0.53	-0.43	-0.52	-0.10
2. Carcass meatiness traits								
• Carcass weight (CW)	gm	-0.73	-0.59	-0.73	-0.70	-0.56	-0.74	-0.80
• Dressing Percentage (DP)	unit	0.38	0.13	0.24	0.02	0.14	0.05	0.40
• Muscle: bone (MB)	unit	0.36	0.30	0.36	0.35	0.28	0.36	0.37
• Muscle: Fat (MF)	unit	-1.6	-0.41	-1.40	-1.53	-0.23	-1.82	-4.41

‡: WW= Weaning weight; SW= Slaughter weight, DG= Daily gain

135.52 gm in slaughter weight, and 0.78gm/day in average daily gain (Table 4). Whereas applying the reduced index (I_3) including WW and DG was found to be as efficient as the full index in improving the aggregate genotype traits by 112.93gm in weaning weight, 135.31gm in slaughter weight, and 0.73gm/day in daily gain compared to the other reduced indices. However, compared to the full index, the single trait index including WW only (I_5) appeared to be the best single index in the enhancement of true breeding value represented in WW and SW by 118.46 gm and 124.70, respectively with a decline in DG improvement to be 0.32gm/day due to the nature of genetic correlation for WW with each of SW and Daily gain (Table 2). Moreover, selection based on the earlier trait weaning weight would be effective for the rabbit breeders in saving time and nutrition costs.

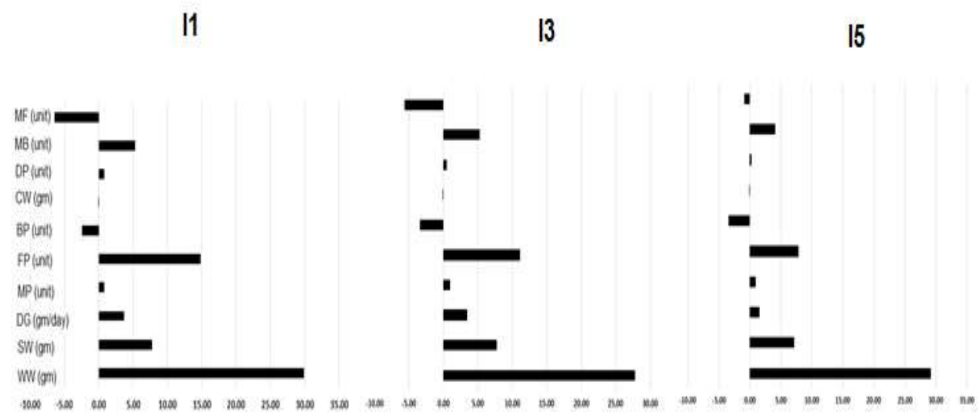

Figure 1. Expected genetic change to selection for post-weaning growth traits expressed as percentage of overall mean

WW= Weaning weight, SW= Slaughter weight, DG= Daily gain, MP= Muscle percentage, FP= Fat percentage, BP= Bone percentage, CW= Carcass weight, DP= Dressing percentage, MB= Muscle: Bone, MF= Muscle: Fat.

ii. ***Carcass attributes*.**

Consequences of selection for post-weaning growth traits on carcass attributes were examined (Table 4). Using all sources of information in the selection index (I_1) would consequently develop rabbits with favorable muscle percentage (+66.5unit), bone percentage (-0.31unit), dressing percentage (+0.38unit), and muscle bone ratio (+0.36unit), and unfavorable fat percentage (+0.59unit), carcass weight (-0.73gm) and muscle fat ratio (-1.6unit). However, excluding the SW from the full index in the reduced index (I_3)

would enhance the expected genetic change in favorable muscle percentage (+15.51unit) and bone percentage (-0.11unit) and decline the deterioration in unfavorable fat percentage (+0.15unit), muscle to fat ratio (-0.20unit). Applying the single trait index including weaning weight was found to be as efficient as the full index in relation to the expected genetic change in carcass composition represented in MP, FP, and BP by +8.61unit, -0.28unit and -0.12unit, respectively with a decrease the deterioration in carcass weight by 0.17gm and muscle to bone ratio by 1.37unit.

Lower previous attempts which investigated the impact of selection for post-weaning growth traits on carcass attributes were observed. In agreement with present results, Shemeis and Abdallah (2000) reported an increasement in muscle (+0.15unit) and fat percentage (+3.0unit) as an expected response to applying an index including body-weight at marketing and heart girth measure.

Conclusion

Use of weaning weight (WW) and daily gain (DG) as sources of information in the following index (I_3):

$$\boldsymbol{I_3 = 4.21WW + 71.74\ DG\ (r_{TI} = 0.79)}$$

would be recommended to achieve the true breeding value in the present study with an expected impact favorably on the percentage of muscle, bone, dressing percentage and muscle to one ratio and unfavorably on fat percentage, carcass weight and muscle to fat ratio. However, If the rabbit breeder aims to increase his profitability through an early selection of his animals, with an acceptance of a reduction in selection accuracy with a decline in accelerating daily gain, then the following single trait index:

$$\mathbf{I_5 = 4.46\ WW\ (r_{TI} = 0.76)}$$

would be recommended with an expected positive impact on muscle percentage, bone percentage, and muscle to bone ratio.

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توابع الانتخاب لأداء النمو بعد الفطام على خواص الذبيحة في الأرانب

جوده فتحي جوده ، أحمد راغب شميس
قسم الإنتاج الحيواني ، كلية الزراعة ، جامعة عين شمس ، شبرا الخيمة 11241 القاهرة ، مصر.

يهدف هذا العمل الى بحث التأثير المتوقع للانتخاب لأداء النمو بعد الفطام في الأرانب على خواص الذبيحة والمتمثلة في الصفات الدالة على التكوين النسيجى والتكوين اللحمى للذبيحة. تم تطبيق سبعة أدلة انتخابية معتمدة على تقديرات المعالم الوراثية والمظهرية المقدرة على 218 أرنب من سلالة النيوزيلندى الأبيض (NZW) من خلال النموذج الحيواني متعدد الصفات. تم استخدام وزن الفطام (WW) ووزن الذبح (SW) ومعدل النمو اليومى بينهما (DG) كمصادر للمعلومات. كان الهدف التربوى هو تحسين ربحية مربي الأرانب النيوزيلندية من خلال تعظيم WW ، SW ، DG . تضمنت الصفات الدالة على التكوين النسيجى للذبيحة نسبة العضلات (MP) ، ونسبة الدهن (FP) ، ونسبة العظام (BP) في نصف الذبيحة، بينما تضمنت الصفات الدالة على التكوين اللحمى للذبيحة وزن الذبيحة (CW) ، ونسبة التصافى (DP) ، ونسبة العضلات الى العظام (MB) ونسبة العضلات الى الدهن (MF). أظهرت النتائج أن تقديرات المكافئ الوراثى (h^2) كانت 0.69 ، 0.44 ، 0.54 لكل من وزن الفطام و وزن الذبح و معدل النمو اليومى على التوالي. كانت تقديرات المكافئ الوراثى للصفات الدالة على التكوين

النسيجى للذبيحة لنسبة العضلات (0.31) ونسبة الدهن (0.35) بينما كانت مرتفعة جدا لنسبة العظام (0.91). في حين كانت قيم المكافآت الوراثية للصفات الدالة على التكوين اللحمى 0.42 ، 0.43 ، 0.89 ،0.75 لوزن الذبيحة و نسبة التصافى و نسبة العضلات الى العظام و نسبة العضلات الى الدهن ، على التوالي.

كان للدليل الكامل (I_1) = 6.39 وزن الفطام – 1.85 وزن الذبح + 150.92 معدل النمو اليومى أعلى ارتباط مع التركيب الوراثي الكلي (r_{TI} = 0.81) ، يليه أفضل دليل مخفض يحتوى على صفتين (r_{TI} = 0.79) والذى يتضمن وزن الفطام ومعدل النمو: **(I_3)** = 4.21 وزن الفطام + 71.74 معدل النمو اليومى .

بينما أظهر الدليل الفردى المعتمد على صفة وزن الفطام فقط (I_5= 4.46 وزن الفطام) كفاءة معادلة لكفاءة الدليل المخفض المحتوى على صفتين (r_{TI} = 0.76) .

في كل جولة من الانتخاب مع شدة انتخاب = 1.0 من المتوقع أن يؤدي كل من I_1، I_3 ، I_5 إلى انتاج أرانب نيوزيلندى ذات أداء نمو أفضل بعد الفطام في صورة وزن جسم أثقل عند الفطام (بمقدار من 112.93 الى 121.35 جم) وعند الذبح (بمقدار من 124.70 إلى 135.52 جم) مع معدل نمو يومى أسرع (بمقدار من 0.32 إلى 0.78 جم / يوم). هذا التحسين السابق من المتوقع أن يرافقه زيادة في نسبة العضلات (بمقدار من 0.67 إلى 0.82 وحدة) وفي نسبة الدهن (بمقدار من 0.31 إلى 0.59 وحدة) مع انخفاض في نسبة العظام (بمقدار من 0.31- إلى 0.43- وحدة). كما انه من المتوقع أن تتحسن الصفات المتعلقة بالتكوين اللحمى للذبيحة من حيث نسبة التصافى (بمقدار من 0.14 إلى 0.38 وحدة) ونسبة العضلات إلى العظام (بمقدار من 0.28 إلى 0.36 وحدة) مع انخفاض متوقع في نسبة العضلات الى الدهن (بمقدار من 1.60- إلى 0.23- وحدة) .

التوصية: أوصت النتائج المتحصل عليها في الدراسة الحالية بالانتخاب للدليل الفردى I_5 المبنى على صفة وزن الفطام منفرداً لتحسين صفات الوراثة الكلية المتعلقة بصفات النمو بعد الفطام لكون وزن الفطام صفة مبكرة ، وفردية ، وسهلة القياس**.**

الكلمات المفتاحية: الأرانب – أدلة الانتخاب - صفات النمو بعد الفطام – صفات التكوين النسيجى للذبيحة – صفات التكوين اللحمى للذبيحة.