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A TRAIL TO GRADE NEW ZEALAND WHITE RABBITS FOR BROILER PRODUCTION AT MARKETING AND BREEDING

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SUMMARY : Eighty healthy New Zealand White male rabbits, at marketing age (90 days), were used in this study. All available measurements and their indices on the live animals with half of one standard deviation difference were used to classify the carcasses and their associated traits to definite classes according to fleshing and superiority of the prime cuts. With this aim in view, correlation coefficients between each pair of traits studied, coefficients of determination and prediction equations for some carcass traits by stepwise and simple methods, were estimated to define the important measurements in predicting mainly fleshing and prime cuts. Correlation coefficients between each pair of traits studied within each of the grades of live body weight (LBW)/thigh length (TL) and LBW/body length, were also calculated. Only the LBW/TL index succeeded in separation of the carcass traits and the associated body measurements to three grades. Within LBW/TL index, the mean traits and the edible meat were high in the first grade, followed by the second and third grades, respectively. The differences in traits between the various grades were highly significant ($P<0.01$). Within each of the grades of the same index, correlation coefficients between LBW and each of the high quality meat traits were generally high, positive and significant, and decrease from the first to the third grade, respectively.

RÉSUMÉ : Moyen d'évaluation pour l'élevage et la vente de lapins de chair Néo Zélandais Blancs.
Quatre vingt lapins mâles Néo Zélandais blancs sevrés, en bonne santé, en âge d'être vendus (90 jours) ont été utilisés pour cette étude. Toutes les mesures disponibles et leurs index sur l'animal vivant avec une différence de 1/2 déviation standard ont été utilsées pour classifier les carcasses et leurs caractéristiques associées afin de définir des catégories en rapport avec la charnure et la prépondérance des morceaux de première catégorie. Dans ce but, les coefficients de correlation entre chaque paire de caractères étudiés, les coefficients de détermination et les équations prévisionnelles pour quelques caractéristiques de carcasses ont été calculés par régressions simples et régressions multiples et progressives, pour définir quelles sont les mesures prévisionnelles majeures pour prévoir la charnure et les morceaux de première catégorie. Les coefficients de correlation entre chaque paire de caractères étudiés dans chacune des catégories de Poids vif/Longueur de la cuisse et Poids vif/Longueur du corps, ont été aussi calculés. Seul l'index Poids vif/Longueur de la cuisse parvient à départager les caractéristiques de carcasse et les autres mesures corporelles associées dans les trois catégories.
Dans l'index Poids vif/Longueur de la cuisse, la moyenne des caractéristiques et de la viande consommable était élevée dans la première catégorie, venait ensuite la deuxième puis la troisième, respectivement. Les différences des caractéristiques entre les différentes catégories étaient hautement significatives ($P<0.01$). Dans chacune des catégories, pour la même index, les coefficients de corrélation entre le Poids Vif et chacune des caractéristiques déterminant la haute qualité de la viande, étaient généralement haut, positif et significatif et decroissait de la première vers la troisième catégorie, respectivememnt.

INTRODUCTION

The traditional methods used in grading the live meat type animals have mostly been based on visual assessment of quality and conformation.

An accurate and quick assessment of the live body and carcass composition of animals is essential in establishing more determinant objectives in meat production. However, similar assessment in broiler rabbits is lacking.

The present study aimed to find out live body measurements or indices to classify broiler New Zealand White male carcasses with half of one standard deviation difference, to different grades according mainly to fleshing and superiority of the prime cuts.

MATERIALS AND METHODS

The study was carried out at the Rabbitry belonging to the Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt, on November to January 1993, on 80 male broiler New Zealand White rabbits weaned at 35 days of age. The animals were fed *ad libitum* a diet

Table 1 : Averages ± standard errors and ranges of traits studied in New Zealand White broiler rabbits (n = 80).

Traits	Averages	Ranges
Live body measurements (cm)		
Live body weight (LBW)	2162.2 ± 23.77	1680.0 – 2820.0
Body length (BL)	32.7 ± 0.21	26.0 – 37.0
Heart girth (HG)	28.1 ± 0.21	24.0 – 32.5
Pelvic girth (PG)	32.0 ± 0.25	27.0 – 39.5
Shoulder width (SW)	8.7 ± 0.11	7.0 – 10.0
Fore cannon length (FCL)	8.5 ± 0.07	7.0 – 9.5
Thigh length (TL)	12.5 ± 0.08	11.5 – 14.5
Carcass traits (g)		
Carcass weight (HCW)	1250.3 ± 16.91	932.0 – 1797.0
Liver weight (LW)	72.6 ± 1.37	50.0 – 99.0
Kidney weight (KW)	15.4 ± 0.23	10.0 – 20.0
Kidney fat weight (KFW)	19.8 ± 0.79	5.0 – 42.0
Carcass length (LL)	29.9 ± 0.25	25.0 – 34.0
Thigh circumference (TC)	13.5 ± 0.08	11.5 – 17.0
Head weight (HW)	130.2 ± 1.39	105.0 – 165.0
Fore part weight (FPW)	276.0 ± 4.63	195.0 – 385.0
Intermediate part weight (IPW)	329.0 ± 5.68	215.0 – 530.0
Hind part weight (HPW)	407.0 ± 5.74	300.0 – 590.0
IPW + HPW (PCW)	736.3 ± 6.64	535.0 – 1120.0
Dressing percentage (DP)	57.7 ± 0.27	51.9 – 63.7

containing 16.3 % crude protein, 12.44 % crude fibre and 2670 Kcal/kg calculated on dry matter basis according to NRC (1977) from weaning up to the marketing age at 90 days. Fresh water was available all time in the used batteries. All animals were under the same open sided building conditions.

At 90 days of age and before slaughtering, all animals were fasted for 12 hours (LUKEFAHR, 1992), then individually weighed and live body dimensions were measured. The measurements recorded on the live animals were body length (BL), heart girth (HG), pelvic girth (PG), shoulder width (SW), fore cannon length (FCL) and thigh length (TL). After slaughtering and complete bleeding, the animals were dressed according to BLASCO *et al.* (1992). The following measurements were recorded 30 minutes after slaughtering : hot carcass weight (HCW), liver weight (LW), kidney weight (KW), kidney fat weight (KFW), head weight (HW), fore part weight (FPW), intermediate part weight (IPW), hind part weight (HPW), IPW + HPW (PCW) as prime cuts, carcass length (LL) and thigh circumference (TC).

All measurements on live bodies and their ratios with half of one standard deviation difference were used to classify the carcases and their fleshing and superiority of the prime cuts. With this aim in view, correlation coefficients between each pair of traits studied, coefficients of determination and prediction equations for some traits by stepwise and simple methods, were estimated to define the important measurements in predicting mainly both fleshing and prime cuts. Correlation coefficients between each pair of the traits studied within each of the grades of LBW/TL and LBW/body length, were also calculated.

Statistical analysis was carried out by SAS program (SAS, 1982) where simple and multiple regression equations were fitted to the data to predict each of HCW and prime cuts using stepwise and simple statistical methods. The coefficients of determination (R^2) were used to compare the effectiveness of the various equations for predicting a specific dependent variable. Analysis of variance was carried out according to complete randomized design.

RESULTS AND DISCUSSION

Live body and carcass traits

Table 1 shows averages and ranges of traits studied either on live animals or on their carcasses for all animals.

Table 2 : Correlation coefficients between each pair of the traits studied in New Zealand White rabbits (n° = 80).

Items	BL	HG	PG	SW	FCL	TL	LBW	HCW	LW	KI	KF	HW	FPW	IPW	HPW	PCW
HG	0.443															
PG	0.231	0.587														
SW	0.341	0.208	0.103													
FCL	0.374	0.379	0.245	0.192												
TL	0.315	0.285	0.222	0.070	0.501											
LBW	0.620	0.643	0.446	0.369	0.557	0.597										
HCW	0.602	0.673	0.370	0.413	0.495	0.509	0.941									
LW	0.435	0.469	0.472	0.138	0.233	0.459	0.623	0.553								
KW	0.305	0.321	0.379	0.190	0.153	0.060	0.270	0.304	0.390							
KFW	0.287	0.303	0.304	0.239	0.042	0.066	0.401	0.492	0.345	0.348						
HA	0.602	0.501	0.191	0.342	0.510	0.354	0.703	0.687	0.354	0.269	0.268					
FPW	0.540	0.653	0.325	0.323	0.451	0.436	0.882	0.927	0.452	0.189	0.373	0.612				
IPW	0.512	0.552	0.304	0.458	0.413	0.492	0.819	0.912	0.485	0.303	0.530	0.556	0.773			
HPW	0.529	0.621	0.310	0.347	0.494	0.454	0.865	0.917	0.397	0.193	0.325	0.604	0.842	0.736		
PCW	0.559	0.630	.0330	0.432	0.487	0.507	0.904	0.981	0.473	0.266	0.458	0.623	0.867	0.931	0.932	
DP	0.275	0.420	0.023	0.316	0.141	0.069	0.346	0.641	0.120	0.236	0.454	0.315	0.579	0.664	0.587	0.671

Values higher than 0.220 are significant ($P<0.05$) ; n° = number of rabbits used.

CHEN *et al.* (1978) reported that LBW was of narrow range, while AYYAT (1991) reported higher average of the same trait, in the same NZW breed. At the same time, HCW showed wide range, while the same trait average was higher than that reported by NIEDZWIADECK (1983) and lower than that recorded by AYYAT (1991) in the same breed. These differences in the results may be due to differences in genotype, weaning age, nutrition and environmental conditions. It was also observed that the prime cuts (IPW and HPW) percentage was 58.89 % of hot carcass weight, which is nearly similar to that found by AYYAT (1994) in the same breed (range 58.8 - 59.9 %) and by SZENDRÖ *et al.* (1994) in Pannon White breed (61.63 %).

Correlation coefficients between most of each pair of the traits studied were positive and significant (Table 2).

Coefficients of determination (R^2) and prediction equations constructed by stepwise statistical method illustrated that R^2 increased, while regression coefficient (b) and Y intercept values decreased when using more than one measurement in predictions of HCW and prime cuts (Table 3).

The obtained findings clarified the importance of TL, HG, PG and SW live body measurements and LBW in predicting HCW and prime cuts.

Suggested grades

All measurements obtained on live body of rabbits with half of one standard deviation difference were used to separate the carcasses and their associated traits to definite three grades according to fleshing and superiority of the prime cuts, but none showed complete separation. Therefore, some indices were constructed according to the significant associations between each pair of traits studied and were used with half of one standard deviation difference for the same purpose, i.e. to separate the carcasses and their associated traits to definite three grades. The indices constructed were as follows : (1) BL/LBW × 100, (2) HG/LBW × 100, (3) TL/LBW × 100, (4) PG/LBW × 100, (5) SW/LBW × 100, (6) FCL/LBW × 100, (7) LBW/PG, (8) LBW/SW, (9) LBW/FCL, (10) LBW/HG, (11) LBW/BL and (12) LBW/TL.

The results showed that LBW/TL index succeeded in separation of the carcasses and their associated traits into three definite grades (Table 4 and Figures 1–4), while LBW/BL index separated the carcass traits into the same grades, but not all live measurements (Table 4 and Figures 5–8). Tables 5 and 6 evidently showed that the three grades differed significantly ($P<0.01$) in the important traits except TL in the first chosen index and BL, SW in the second index which did not differ significantly. The highest mean traits (including index mean) were in the first

grade, followed by the second and the third grades, respectively (Table 4).

Within the LBW/TL index, it is evident that index mean decreased from the first to the third grade in addition to that the dressing percentage also decreased from the first grade to the third one. It is also worthy to illustrate that the ratios of HW/HCW and HW/LBW decreased from the third to the first grade. These findings showed that HW was relatively lighter in the first grade than those in the other two grades which proved that edible meat increases in the first grade followed by the second and third grades, respectively.

Correlation coefficients of associations among each pair of the traits relating to high quality meat weight within each grade of the two indices used, are presented in Tables 7 and 8. The correlations between LBW and various carcass traits were high, positive and significant ($P<0.05$). The LBW–HCW and LBW–carcass cuts associations showed the highest estimates, indicating the importance of LBW in predicting HCW and high quality meat weight. It is also observed that the estimates were generally high in the first grade, then it decreased in the other two grades, respectively. The same trend was also observed in HCW and carcass cuts associations with each other or with the other traits studied within each grade of the two indices used.

Conclusively, the live body weight/thigh length index could be used for classification of rabbits for meat production to different grades both at marketing and breeding.

Table 3 : Coefficients of determination and prediction equations for some carcass traits studied in New Zealand White rabbits by stepwise and simple statistical methods.

Associations	R^2	Prediction equations
	By stepwise method	
Carcass weight on		
LBW/TL	0.675	$-326.887 + 9.289\ X$
LBW/TL & TL	0.888	$-1578.640 + 8.980\ X + 102.442X_2$
LBW/TL, TL & HG	0.893	$-1613.255 + 8.333X_1 + 97.154X_2 + 7.540X_3$
LBW/TL, TL, HG & PG	0.903	$-1533.052 + 8.446X_1 + 99.060X_2 + 12.574X_3 - 8.287X_4$
Intermediate part weight on		
LBW/TL	0.464	$-110.504 + 2.590X$
LBW/TL & TL	0.669	$-523.117 + 2.488X_1 + 33.768X_2$
LBW/TL, TL & SW	0.698	$-598.999 + 2.194X_1 + 33.120X_2 + 15.456X_3$
Hind part weight on		
LBW/TL	0.580	$-89.002 + 2.921X$
LBW/TL & TL	0.747	$-466.093 + 2.828X_1 + 30.861X_2$
Prime cuts weights on		
LBW/TL	0.600	$-199.506 + 5.511X$
LBW/TL & TL	0.814	$-989.210 + 5.317X_1 + 64.629X_2$
LBW/TL, TL & SW	0.823	$-107.476 + 4.998X_1 + 63.926X_2 + 6.757X_3$
	By simple method	
Carcass weight on		
LBW	0.885	$-196.824 + 0.669X$
Intermediate part weight on		
LBW	0.670	$-94.048 + 0.196X$
Hind part weight on		
LBW	0.748	$-44.245 + 0.209X$
Prime cuts weight on		
LBW	0.816	$-138.292 + 0.405X$

Table 4 : Averages ($\bar{x}$ ± SE) of important traits studied according to grades within the chosen indices used for New Zealand White rabbits classification

Items	LBW/TL Grade I	LBW/TL Grade II	LBW/TL Grade III	LBW/BL Grade I	LBW/BL Grade II	LBW/BL Grade III
N°	24	34	22	20	36	24
			Live measurements (cm)			
Index	185.5 ± 1.72	168.5 ± 0.60	154.7 ± 1.52	73.4 ± 0.67	65.7 ± 0.21	60.6 ± 0.28
BL	33.7 ± 0.37	33.0 ± 0.19	31.2 ± 0.44	32.4 ± 0.58	33.0 ± 0.26	32.6 ± 0.32
HG	29.5 ± 0.36	28.0 ± 0.25	26.7 ± 0.36	29.2 ± 0.38	28.2 ± 0.28	27.0 ± 0.39
PG	33.2 ± 0.29	31.8 ± 0.43	30.9 ± 0.42	33.3 ± 0.60	31.8 ± 0.32	31.2 ± 0.39
SW	9.0 ± 0.12	8.7 ± 0.11	8.4 ± 0.10	8.7 ± 0.15	8.8 ± 0.10	8.5 ± 0.13
FCL	8.7 ± 0.08	8.5 ± 0.10	8.1 ± 0.13	8.8 ± 0.13	8.5 ± 0.08	8.1 ± 0.12
TL	12.9 ± 0.15	12.7 ± 0.12	12.6 ± 0.13	13.2 ± 0.17	12.7 ± 0.10	12.4 ± 0.11
LBW (g)	2391.9 ± 33.47	2134.4 ± 19.24	1954.5 ± 25.34	2376.8 ± 49.75	2168.9 ± 20.66	1973.3 ± 23.87
			Carcass traits (g)			
HCW	1409.8 ± 27.36	1224.7 ± 14.00	1115.8 ± 14.57	1379.0 ± 40.35	1264.1 ± 15.42	1122.3 ± 16.93
LW	80.3 ± 2.36	71.6 ± 2.02	65.8 ± 1.94	81.4 ± 3.00	70.9 ± 1.68	68.0 ± 2.19
KFW	24.2 ± 1.59	18.5 ± 1.09	17.1 ± 1.02	21.3 ± 1.66	20.9 ± 1.26	17.1 ± 1.03
HW	140.8 ± 2.32	128.2 ± 1.54	121.7 ± 2.17	136.3 ± 3.40	131.4 ± 1.75	123.3 ± 1.93
FPW	320.8 ± 6.36	266.9 ± 4.21	241.4 ± 5.89	309.8 ± 9.92	282.3 ± 4.65	238.5 ± 4.90
IPW	375.6 ±10.86	320.6 ± 5.32	292.5 ± 7.11	368.0 ± 14.86	330.2 ± 5.51	295.5 ± 6.70
HPW	452.0 ± 9.58	404.2 ± 5.29	362.4 ± 8.51	446.9 ± 12.52	412.9 ± 5.38	365.0 ± 8.15
PCW	827.6 ±19.82	724.5 ± 8.92	654.9 ± 11.30	814.9 ± 26.58	743.1 ± 9.51	660.5 ± 11.28
DP %	58.99	57.38	57.09	58.02	58.28	56.87

Figure 1 : Weights of the traits in the suggested grades as classified by LBW/TL index

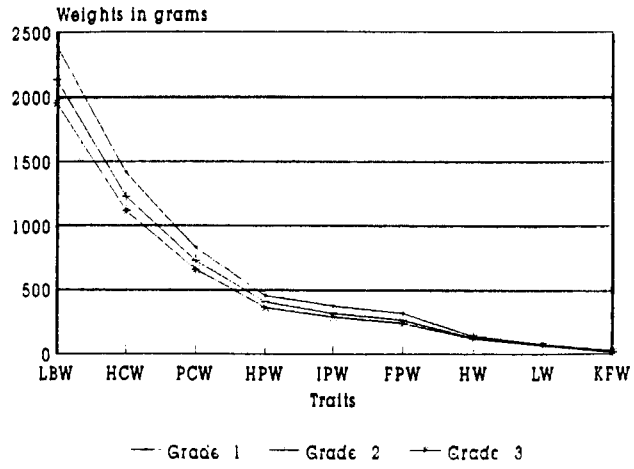

Figure 2 : Live body dimensions in the suggested grades as classified by LBW/TL index

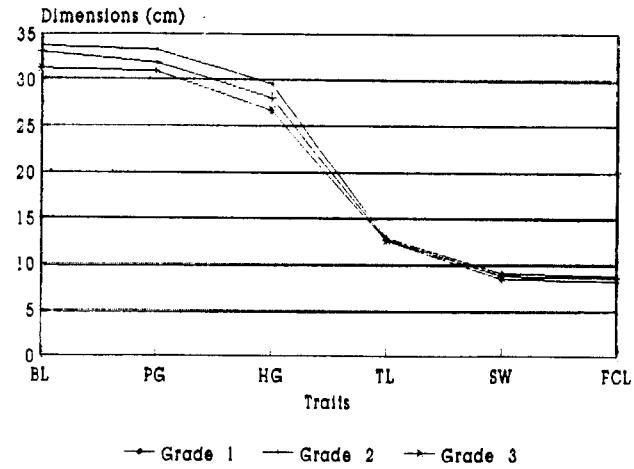

Figure 3 : Differences in weights between the suggested grades as classified by LBW/TL index when considering grade 2 as 100%

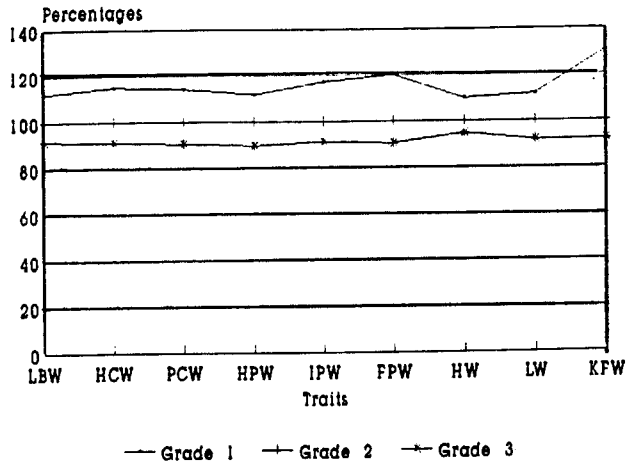

Figure 4 : Measurement differences between the suggested grades as classified by LBW/TL index when considering grade 2 as 100 %

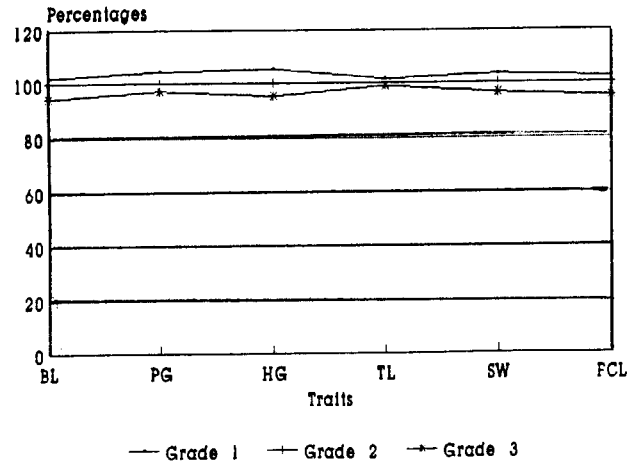

Figure 5 : Weights of the traits in the suggested grades as classified by LBW/BL index.

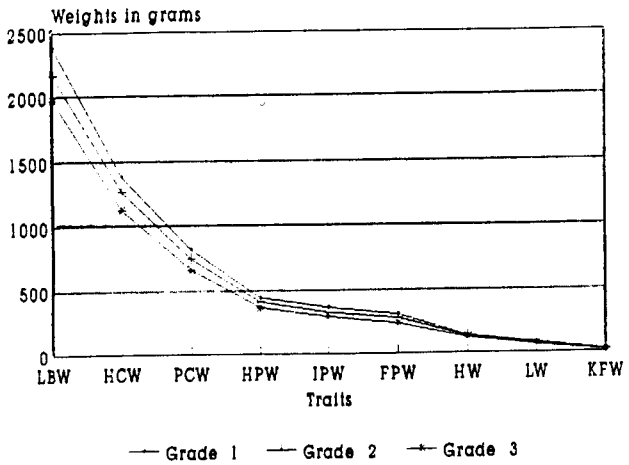

Figure 6 : Live body dimensions in the suggested grades as classified by LBW/BL index.

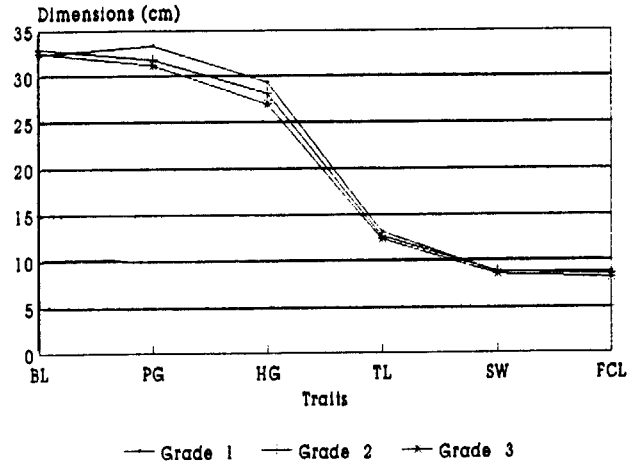

Figure 7 : Differences in weights between the suggested grades as classified by LBW/BL index when considering grade 2 as 100 %.

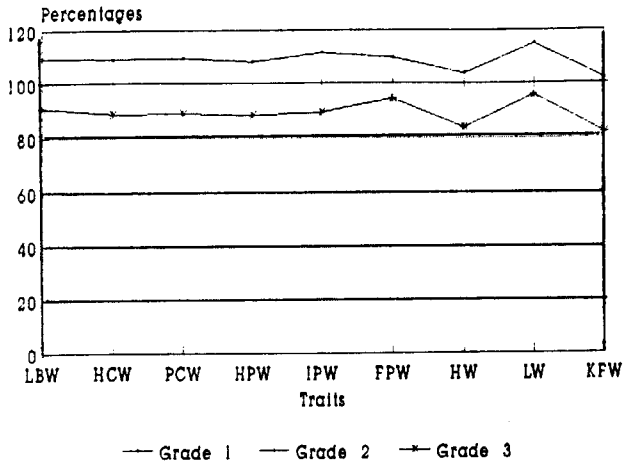

Figure 8 : Measurement differences between the suggested grades as classified by LBW/BL index when considering grade 2 as 100 %.

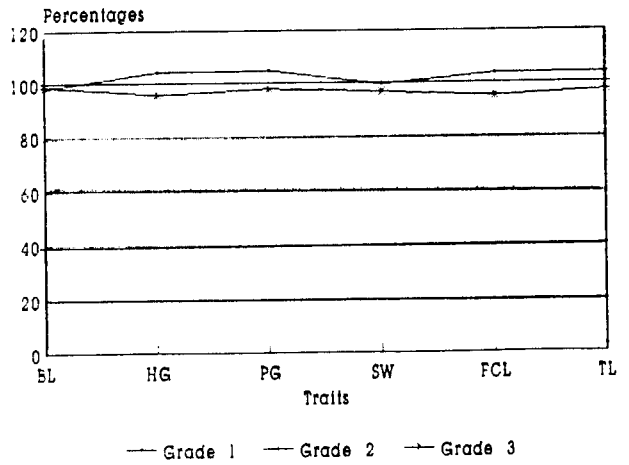

Table 5 : Analysis of variance for live traits studied represented in the chosen two indices used for grading New Zealand White rabbits

		Mean squares							
S.O.V.	**DF**	**Index**	**BL**	**HG**	**PG**	**SW**	**FCL**	**TL**	**LBW**
					LBW/TL index				
Between grades	2	703.66**	38.18**	45.75**	32.04**	2.09**	2.36**	0.47NS	1120458.94**
Within grades	77	3.56	2.63	2.57	4.36	0.34	0.30	0.46	17273.04
					LBW/BL index				
Between grades	2	5511.81**	2.69NS	26.75**	25.22**	0.59NS	2.83**	3.87**	889169.7**
Within grades	77	40.33	3.55	3.07	4.53	0.38	0.29	0.38	23280.55

** : P<0.01 ; * : P<0.05 ; NS : not significant.

Table 6 : Analysis of variance for carcass traits studied represented in the chosen two indices used for grading New Zealand White rabbits.

S.O.V.	**DF**	**HCW**	**LW**	**KFW**	**HW**	**FPW**	**IPW**	**HPW**	**PCW**
					LBW/TL index				
Between grades	2	515434.97**	1222.807**	336.96**	2227.57**	38739.10**	42018.46**	46262.37**	175228.12**
Within grades	77	10076.63	121.735	41.94	101.62	1560.92	1560.92	1500.35	4742.96
					LBW/BL index				
Between grades	2	365845.79**	1090.90**	129.83+	978.37**	28943.77**	28667.65**	37678.65**	131414.79**
Within grades	77	13962.06	125.16	47.32	133.99	1011.11	1907.69	1723.32	5880.97

** : P<0.01 ; * : P<0.05 ; + : P<0.10

Table 7 : Correlation coefficients between each pair of the traits relating to high quality meat weight within each of the grades of LBW/TL index in New Zealand White rabbits.

Items	Index	BL	HG	PG	SW	FCL	TL	LBW	HCW	FPW	IPW	HPW
BL I	0.469											
II	0.276											
III	0.178											
HG I	0.448	0.163										
II	-.080	0.317										
III	0.399	0.243										
PG I	0.129	0.213	0.546									
II	0.025	-.137	0.547									
III	0.254	0.145	0.386									
SW I	0.338	0.506	0.259	0.094								
II	0.009	0.123	-.299	-.445								
III	0.235	-.054	0.173	-.314								
FCL I	0.010	-.034	-.025	0.311	-.027							
II	-.365	-.002	0.064	0.020	0.072							
III	0.433	0.571	0.606	0.199	0.100							
TL I	-.091	0.175	-.019	0.349	0.070	0.159						
II	-.301	0.197	0.390	0.185	-.082	.0610						
III	-.165	0.581	0.399	0.023	0.174	0.643						
LBW I	0.583	0.449	0.284	0.364	0.281	0.130	0.756					
II	0.080	0.323	0.375	0.204	-.082	0.488	0.923					
III	0.623	0.603	0.610	0.207	0.302	0.842	0.668					
HCWI	0.670	0.377	0.450	0.200	0.331	0.059	0.509	0.860				
II	0.112	0.510	0.386	0.067	0.065	0.351	0.736	0.819				
III	0.542	0.529	0.639	0.144	0.345	0.845	0.651	0.922				
FPW I	0.608	0.388	0.370	0.201	0.188	-.024	0.502	0.809	0.854			
II	0.106	0.498	0.317	-.100	-.023	0.206	0.498	0.565	0.833			
III	0.521	0.204	0.673	0.157	0.101	0.729	0.480	0.775	0.829			
IPW I	0.614	0.248	0.428	0.095	0.386	0.082	0.401	0.739	0.953	0.741		
II	-.122	0.288	0.149	-.005	0.245	0.309	0.631	0.618	0.811	0.567		
III	0.114	0.524	0.327	0.207	0.349	0.471	0.631	0.576	0.618	0.282		
HPW I	0.594	0.300	0.399	0.238	0.263	0.113	0.550	0.844	0.935	0.718	0.881	
II	0.274	0.552	0.357	0.067	-.032	0.340	0.585	0.724	0.529	0.739	0.424	
III	0.498	0.178	0.453	-.082	0.260	0.607	0.273	0.592	0.474	0.678	0.040	
PCW I	0.623	0.281	0.427	0.167	0.339	0.100	0.485	0.813	0.974	0.753	0.974	0.965
II	0.090	0.499	0.301	0.037	0.127	0.386	0.724	0.798	0.975	0.776	0.842	0.840
III	0.447	0.464	0.546	0.068	0.415	0.753	0.603	0.808	0.951	0.688	0.659	0.778

I : First grade ; II : Second grade ; III : Third grade

Table 8 : Correlation coefficients between each pair of the traits relating to high quality meat weight within each of the grades of LBW/BL index in New Zealand White rabbits.

Items	Index	BL	HG	PG	SW	FCL	TL	LBW	HCW	FPW	IPW	HPW
BL I	0.126											
II	0.308											
III	0.317											
HG I	0.390	0.468										
II	0.295	0.455										
III	0.254	0.687										
PG I	0.136	0.155	0.427									
II	0.348	0.504	0.626									
III	0.191	0.160	0.515									
SW I	0.337	0.278	0.096	-.583								
II	0.141	0.447	0.266	0.246								
III	0.338	0.295	0.081	-.181								
FCL I	-.076	0.377	0.033	0.284	-.248							
II	0.110	0.372	0.309	0.113	0.213							
III	0.354	0.612	0.289	-.061	0.386							
TL I	0.260	0.533	0.205	0.195	0.092	0.591						
II	0.479	0.287	0.032	0.110	-.058	0.343						
III	0.022	0.259	0.141	-.179	0.047	0.197						
LBW I	0.543	0.901	0.572	0.188	0.387	0.277	0.568					
II	0.601	0.946	0.481	0.545	0.422	0.346	0.404					
III	0.636	0.933	0.658	0.198	0.365	0.361	0.223					
HCWI	0.630	0.746	0.592	0.030	.0477	0.087	0.348	0.910				
II	0.450	0.881	0.641	0.596	0.423	0.398	0.324	0.893				
III	0.654	0.896	0.613	0.069	0.362	0.615	0.295	0.905				
FPW I	0.570	0.703	0.518	-.017	0.475	-.114	0.203	0.845	0.466			
II	0.311	0.713	0.609	0.467	0.241	0.365	0.278	0.704	0.599			
III	0.409	0.837	0.577	0.005	0.088	0.582	0.134	0.838	0.426			
IPW I	0.666	0.638	0.533	-.081	0.565	0.118	0.365	0.835	0.555	0.847		
II	0.319	0.670	0.443	0.522	0.417	0.308	0.151	0.672	0.350	0.574		
III	0.216	0.583	0.348	0.146	0.403	0.371	0.587	0.556	0.359	0.333		
HPW I	0.696	0.659	0.572	0.142	0.363	0.047	0.346	0.869	0.531	0.876	0.885	
II	0.375	0.768	0.572	0.416	0.332	0.448	0.442	0.771	0.443	0.598	0.527	
III	0.339	0.632	0.403	-.157	0.261	0.490	-.117	0.642	0.520	0.696	0.146	
PCW I	0.700	0.667	0.567	0.022	0.487	0.088	0.367	0.876	0.560	0.886	0.976	0.966
II	0.397	0.822	0.580	0.537	0.429	0.432	0.337	0.825	0.454	0.671	0.877	0.870
III	0.373	0.803	0.497	-.027	0.428	0.574	0.264	0.793	0.589	0.701	0.699	0.810

I : First grade ; II : Second grade ; III : Third grade.

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