STUDY ON THE PERFORMANCE OF NORMAL HAIR, ANGORA AND THEIR RECIPROCAL CROSSBRED RABBITS : 3. GROWTH AND CARCASS TRAITS

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Abstract - Growing performance and slaughter characteristics of purebred NN, AA and crossbred AN and NA young rabbits born from 184 and 172 matings of 63 normal hair Pannon White meat (N) and 67 German Angora (A) does were evaluated. For carcass traits NN, AN, NA and AA rabbits (n=22, 26, 12, 10) were slaughtered between live weight of 2.45 and 2.84 kg. NN rabbits significantly surpassed AA youngs in individual live weight (LW) at 21, 42, 70 and 84 days of age (315, 1082, 2087 and 2541 g vs. 278, 863, 1545 and 1910 g), in daily weight gain (DWG) between 21-42, 42-70 and 70-84 days of age (36.5, 35.8 and 32.6 g/d vs. 27.6, 24.5 and 25.7 g/d) and in mortality (MP) between 21-42, 42-70 and 70-84 days of age (3.3, 5.3 and 2.8 % vs. 8.3, 13.5 and 9.5 %), respectively. In AN crossbreds compared to NN a moderate decrease (0-7.8 % for LW and 6.4-11.2 % for DWG) while in group of NA in contrast to AA a remarkable increase (6.8-25.7 % for LW and 20.3-34.3 % for DWG) were found. The individual heterosis for LW and DWG were 3.8-6.8 and 4.8-6.9 %, resp. With respect to slaughter traits full gastrointestinal tract weight (FGTW), reference carcass weight (RCW), hot carcass weight (HCW), carcass yield (DP), head- (HW), fore- (FPW) and hind part weight (HPW) were lower while commercial skin-(CSkW), distal parts of legs- (LgW) and perirenal fat weight (PFaW) were higher in AA rabbits compared to NN youngs ($P<0.05$). In crossbreds of AN and NA larger DP, liver weight (% RCW) and PfaW (% RCW) with a decreasing tendency of HPW (% RCW) in favour of intermediate part weight (% RCW) were noticed in contrast to NN and AA rabbits ($P<0.05$). Regarding carcass traits an individual heterosis of 2.3, 10.4, and 25.0 % for DP, liver weight and PFaW were noticed.

INTRODUCTION

Beside poorer reproductive ability, Angora rabbits are also characterized by having weaker growth performances compared to meat ones. The explanation of that is the effect of Angora gene or the remaining genome of the rabbit (ROCHAMBEAU, 1988) and / or the heat stress caused by the long wool (BROCKHAUSEN, 1979; FINZI *et al.*, 1992; SCHLOLAUT, 1994). For the weaker performance of Rex rabbits ROCHAMBEAU *et al.* (1986) presumed a pleiotropic effect of the Rex mutation which was also supposed in the case of Angora gene in a crossing experiment with normal hair NZW and Angora rabbits (DAMME *et al.*, 1985).

While in the European countries Angora rabbits are solely breed for their wool yield, in the world's largest Angora wool exporter country of China an important part of the meat production comes from young Angora rabbits. Thus, to meet requirements of both wool and meat production, special local crossbreds such as Chinese Angora (crossing of European Angora and Chinese White), Tanghang (crossing of Chinese and German Angora) or Wanxi (crossing of NZW and German Angora) are used (SHENG, 1992; WANG and ZHENG 1993; COLIN, 1995). In addition, there are also some German experiments about investigating rabbits both for wool and meat production (SCHLOLAUT *et al.*, 1982; DAMME *et al.*, 1985) and also for wool quality (SCHLOLAUT *et al.*, 1981).

However, since there are scarce data about body development and carcass traits in rabbits owing the Angora gene heterozygous or homozygous, the objective of this study was to compare normal hair-, Angora and their crossbred rabbits for growth performances and slaughter traits.

MATERIAL AND METHODS

Investigations were carried out on the Research Station on the Fac. of Animal Sci., Pannon Agric. University. Growth performance and slaughter characteristics of young rabbits born from 184 and 172 matings of 63 normal hair Pannon White meat (N) and 67 German Angora (A) does between June to October in 1994 were evaluated.

Housing, feeding, breeding procedures and number of does, litters and offsprings in the 5 experimental groups have been presented in the previous companion paper (EIBEN *et al.*, 1996b). When it was possible, the pups were fostered from large litters. Youngs were individually marked at 21 days of age and weaned at 42 days (does were transferred). Angora does were sheared some days before AI and the baby wool of their offsprings was harvested at 60 days of age.

All rabbits were slaughtered between live weight of 2450 and 2840 g. The age of NN, AN and NA rabbits ranged between 11 and 12 weeks but AA youngs were 2 or 3 weeks older. The carcass traits of the four genotypes could be compared since the slaughter traits of growing rabbits with different age but similar live weight is identical (SZENDRÖ, 1989; PARIGI-BINI *et al.*, 1992). Before slaughters about 24 h fasting from solids were done. Rabbits were stunned by sudden neck hit. Slaughter traits were determined after BLASCO *et al.* (1993).

Recordings

Growth performances - Individual live weight (LW) at 21, 42, 70 and 84 days of age; daily weight gain (DWG) between 21-42, 42-70 and 70-84 days of age; mortality (MP) between 21-42, 42-70 and 70-84, days of age.

Carcass traits - Standardized live weight (LW); live weight after fasting (FW) and after bleeding (BW); fasting loss (LW-FW/LW)*100); blood weight (FW-BW); commercial skin weight (CSkW); full gastrointestinal tract weight (FGTW); reference carcass weight (RCW=HCW-(HW+LvW+LHKW+PFaW) but without chilling); hot carcass weight (HCW=RCW+HW+LvW+LHKW+PFaW); carcass yield (DP=HCW/FW*100); head- (HW), distal parts of legs- (LgW), liver- (LvW) and trachea+lungs+heart+kidneys (LHKW) weight; perirenal fat weight (PFaW); fore part weight (FPW: cut at cutpoint 1, between the 7 to 8th thoracic vertebra); intermediate part weight (IPW); hind part weight (HPW: cut at cutpoint 3, between the 6 to 7th lumbar vertebra).

Statistical analysis

Data were subjected to analysis of variance or judged by using the Chi square test.

RESULTS AND DISCUSSION

Growth performances

Individual live weight - Similar to that of meat rabbits (GÓMEZ *et al.*, 1992), as there was not any significant difference between sexes, data were pooled. Despite smallest litter size of AA rabbits (EIBEN *et al.*, 1996b), NN youngs had larger LW21 than AA offsprings ($P<0.05$) however, the differences between NN and AN or NA and AA groups were statistically not proven (Table 1). The 37 g heavier LW21 of NN offsprings compared to AA rabbits was mainly due to the dam breed effect (29 g) that may be also related to the superiority of N does in live weight (EIBEN *et al.*, 1996ab). ROCHAMBEAU (1988) also reported that an Angora doe's capacity to foster appears limited. Nevertheless, because of shearing a risk of wounded teats in A females could be also taken into consideration.

In contrast to NN youngs AA rabbits were 11.7, 20.2, 26.0 and 24.8 % lighter at 21, 42, 70 and 84 days of age ($P<0.05$) while the N mothered AN rabbits were only 0, 4.4, 7.2 and 7.8 % smaller compared to NN offsprings whereas NA youngs nursed by A does considerably surpassed AA group by 6.8, 17.6, 25.7 and 21.9 % in order of advancing age, respectively.($P<0.05$). In addition, differences among groups were more pronounced as previous findings of DAMME *et al.* (1985). Except LW21, to the differences among groups both dam and sire breed effects contributed to approximately same degree. In agreement with BRUN *et al.* (1992) and SZENDRÖ *et al.* (1996) the individual heterosis for LW in different ages was between 3.8 and 6.8 % (Table 1).

Although partly probably due to a slightly bigger litter size of (N+A)xA crossing (EIBEN *et al.*, 1996b), both NA and AA youngs born in group (N+A)xA were insignificantly smaller at 21 and 42 days of age than those born from crossings of NxA or AxA, in this respect no differences at 70 and 84 days of age were detected.

Table 1 : Development of live weight, daily weight gain and mortality rate of normal hair (NN), Angora (AA) and

Groups	NN			AN			NA			AA	
Days	n	Mean	s.e.	n	Mean	s.e.	n	Mean	s.e.	n	Mean
					Individual live weight (LW) in g						
21	509	315^{a}	4	446	318^{a}	4	125	297^{b}	7	121	278^{b}
42	494	1082^{a}	9	444	1034^{b}	9	126	1015^{b}	17	115	863^{c}
70	466	2087^{a}	14	419	1937^{b}	15	118	1942^{b}	28	101	1545^{c}
84	445	2541^{a}	17	400	2344^{b}	17	107	2329^{b}	34	93	1910^{c}
					Daily weight gain (DWG) in g/d						
21-42.	490	36.5^{a}	0.3	439	34.0^{b}	0.3	119	33.2^{b}	0.6	114	27.6^{c}
42-70.	464	35.8^{a}	0.3	419	31.8^{b}	0.3	111	32.9^{b}	0.6	100	24.5^{c}
70-84.	436	32.6^{a}	0.4	391	30.5^{b}	0.4	97	31.8^{ab}	0.8	91	25.7^{c}
					Mortality (MP) in %						
21-42.	17	3.3^{b}	-	5	1.1^{a}	-	6	4.8^{bc}	-	10	8.3^{c}
42-70.	25	5.3^{a}	-	20	4.7^{a}	-	5	4.1^{a}	-	14	13.5^{b}
70-84.	13	2.8^{a}	-	10	2.4^{a}	-	3	2.5^{a}	-	9	9.5^{b}

Means within a line with different superscripts are significantly different (P<0.05).

[1] Individual heterosis

Daily weight gain - Group differences in DWG obviously confirm the obtained tendencies for LW. Thus, NN rabbits were superior to AA youngs 24.4, 31.6 and 21.2 % for DWG between 21-42, 42-70 and 70-84 days of age, respectively.(P<0.05). Similarly, while compared to NN rabbits in AN genotype a moderate decrease (6.8, 11.2 and 6.4 %), adversely in crossbreds of NA a remarkable increase (20.3, 34.3 and 23.7 %) as opposed to AA rabbits was observed (P<0.05). Nevertheless, the extreme low 863 g LW42 and 24.5 g/d DWG between 42-70 d. of AA rabbits what were identical (867g and 23.6 g/d) with that of reported by MONG (1992) can be explained by the more than twice so great stress deriving from the originally smaller LW21, weaning at 42 days of age and then first shearing at 60 days of age. Furthermore, the effect of heat stress during summer period which cause a lower feed intake and consequently smaller live weight in meat rabbits (BACCARI *et al.*, 1984; CHIERICATO *et al.*, 1992 and 1995; PLA *et al.*, 1994) is more pronounced in long hair Angora rabbits (FINZI *et al.*, 1992; XU *et al.*, 1992; SCHLOLAUT, 1994) and it enhanced by a limited feed intake directly before and after shearing (SCHLOLAUT, 1987; FARRELL *et al.*, 1992).
The effect of dam and sire breed on DWG was equal. The noticed heterosis for DWG (4.8 to 7.3 %) was identical with other reports (BRUN *et al.*, 1992).

Mortality - Between 21-42 d. the highest value (8.3 %) was found in group AA while it ranged 1.1 to 5.2 % in the other crossing groups (Table 1). The observed higher rate in AA genotype was probably due to a poorer viability of sucklings (presumed smaller individual weight at birth and lower nursing ability of A does). Due to a pronounced stress affecting AA youngs the 42-70 d. MP increased to 13.5 % while it remained only 4.1 to 5.3 % in the other groups (P<0.05). Between 42-84 d. the MP was 24.2 % in AA and 6.8 to 8.3 % in groups of NN, AN and NA. Concerning the whole experimental period it was 34.7 % for AA and 8.5 to 12.0 % for the other three groups. In addition, the MP of both NA and AA youngs born in group (N+A)xA compared to offsprings from crossings of NxA and AxA were not significant higher. Hovewer, partly as a consequence of the better viability of heterozigous rabbits, insignificantly lower MP were noticed in crosses of AN and NA compared to purebred rabbits.

Carcass traits

The distribution of growing rabbits regarding Hungarian market weight (2.5-2.8 kg) are shown in Table 2.

Table 2 : Distribution of growing rabbits regarding market weight (2.5-2.8 kg)

Groups	NN		AN		NA		AA	
	n	%	n	%	n	%	n	%
70 d. of age								
<2450 g	423	90.8^a	398	95.0^b	112	94.9^{ab}	101	100^c
2450-2840	41	8.8^a	21	5.0^b	6	5.1^{ab}	0	0^c
>2840	2	0.4	0	0	0	0	0	0
84 d. of age								
<2450 g	196	44.0^a	240	60.0^b	78	72.9^c	87	93.5^d
2450-2840	151	34.0^a	126	31.5^a	20	18.7^b	6	6.5^c
>2840	98	22.0^a	34	8.5^b	9	8.4^b	0	0^c

Means within a line with different superscripts are significantly different (P<0.05).
N=normal hair Pannon White meat rabbit, A=German Angora rabbit
* Sire breed listed first.

As it can be seen in Table 2, the market weight of 2.5 to 2.8 kg between 77 to 84 days of age was achieved by 56.0, 40.0, 27.1 and only 6.5 % of NN, AN, NA and AA rabbits, respectively.
In agreement with other authors (LUKEFAHR *et al.*, 1992; PARIGI-BINI *et al.*, 1992; PLA *et al.*, 1994 and BERNARDINI *et al.*, 1995) as sex had no significant effect on slaughter traits, data were pooled.
Carcass traits of NN rabbits (Table 3) were consistent with the previous report of SZENDRÖ *et al.* (1992) about Pannon White rabbits. In accordance with the results of DAMME *et al.* (1985) who investigated the slaughter performance of NZW, Angora and their crossbreds, while the CSkW was 3.3 % higher in AA rabbits (P<0.005) no significant difference in LvW % and LHKW % between NN and AA youngs were found. However, FGTW, RCW, HCW, DP, HW, FPW and HPW were lower and LgW and PFaW were higher in AA rabbits compared to NN youngs (P<0.05). Furthermore, in crossbreds of AN and NA similarly to the tendencies noted by DAMME *et al.* (1985) significant larger DP, LvW % and PfaW % were noticed in contrast to purebred NN and AA rabbits. In addition, a decreasing tendency of HPW % in favour of IPW % in heterozygous rabbits was observed.

Table 3 : Slaughter data and dressing percentage of normal hair (NN), Angora (AA) and reciprocal cross

Genotype / n / Slaughter age		NN 22 77-84 d		AN 26 77-84 d		NA 12 77 d		
Traits		**Mean**	**s.e.**	**Mean**	**s.e.**	**Mean**	**s.e.**	**I**
Standardized live wt (LW)	g	2664	21	2631	20	2633	27	26
Live wt after fasting (FW)	g	2517	20	2467	19	2428	27	24
Bloodless body wt (BW)	g	2444^{a}	20	2386^{b}	19	2349^{b}	27	23
Fasting loss = (LW-FW/LW)*100	%	5.5^{A}	0.4	6.2^{A}	0.3	7.8^{B}	0.5	6.
Blood wt = FW-BW	g	74	3	79	3	79	5	86
Commercial skin wt (CSkW)	g	382^{A}	7	381^{A}	6	374^{A}	9	45
Full gastrointestinal tract wt (FGTW)	g	371^{A}	7	355^{A}	7	320^{B}	10	31
Reference carcass wt (RCW)[1]	g	1297^{a}	12	1259^{b}	11	1262^{ab}	15	12
Hot carcass wt (HCW)[2]	g	1553^{a}	13	1524^{ab}	12	1530^{ab}	17	14
Carcass yield (DP=HCW/FW*100)	%	61.7^{A}	0.3	61.8^{B}	0.3	63.0^{A}	0.4	60
Head wt (HW)	g	135^{a}	2	129^{b}	2	129^{ab}	3	12
Distal part of fore+hind legs wt (LgW)	g	82^{A}	1	81^{A}	1	80^{A}	2	89
Liver wt (LvW)	g	64^{a}	2	70^{b}	2	68^{ab}	2	61
Trachea+lungs+heart+kidneys (LHKW)	g	40	1	41	1	40	1	40
Perirenal fat wt (PFaW)	g	17^{A}	2	24^{B}	1	31^{C}	2	27
Fore part wt (FPW)	g	383^{A}	4	372^{AB}	4	365^{BC}	5	35
Intermediate part wt (IPW)	g	415	5	410	5	415	7	40
Hind part wt (HPW)	g	490^{A}	56	465^{B}	5	473^{B}	6	46
Blood	% FW	2.9	-	3.1	-	3.3	-	3.
Commercial skin	% FW	15.2^{A}	-	15.4^{A}	-	15.4^{A}	-	18
Full gastrointestinal tract	% FW	14.8^{A}	-	14.4^{A}	-	13.2^{B}	-	12
Head	% FW	5.4	-	5.2	-	5.3	-	5.
Distal part of fore and hind legs	% FW	3.2^{A}	-	3.3^{A}	-	3.3^{A}	-	3.
Liver	% RCW	5.0^{a}	-	5.6^{b}	-	5.4^{ab}	-	5.
Trachea+lungs+heart+kidneys	% RCW	3.1	-	3.3	-	3.1	-	3.
Perirenal fat	% RCW	1.3^{A}	-	1.9^{B}	-	2.5^{C}	-	2.
Fore part	% RCW	29.5	-	29.5	-	28.9	-	28
Intermediate part	% RCW	32.0	-	32.6	-	32.9	-	32
Hind part	% RCW	37.7^{a}	-	36.9^{b}	-	37.5^{ab}	-	38

Means within a line with different superscripts are significantly different (a,b: $P<0.05$; A,B: $P<0.005$).

* Individual heterosis; [1]: RCW=HCW-(HW+LvW+LHKW+PFaW) and without chilling; [2]: HCW=RCW+HW+LvW+LH

Although heterosis for carcass traits can be assumed to be of minor importance (LUKEFAHR *et al.*, 1992), in accordance with BRUN *et al.* (1992) who reported an individual heterosis of 1 to 2 % for DP and 6 to 12 % for PFaW %, it was 2.3, 10.4, and 25.0 % for DP, LwW and PFaW, respectively (Table 3).

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Etude des performances de lapins à pelage commun, de lapins Angora et de leurs croisements réciproques : 3. Croissance et qualité des carcasses - Les performances de croissance et les qualités bouchères de jeunes lapins de souches pures à pelage commun NN, de souche angora AA et de croisés AN et NA, issus respectivement de 184 et 172 portées nées de 63 femelles Pannon White à pelage commun et de 67 femelles Angora, ont été étudiées. En ce qui conceme les carcasses, les animaux NN, AN, NA, et AA (n= 22, 26, 12, 10) ont été sacrifiés à un poids vif compris entre 2.45 et 2.84 kg. Les poids individuels (LW) des jeunes lapins NN ont été significativement plus élevés que ceux des jeunes AA aux âges de 21, 42, 70 et 84 jours (315, 1082, 2087, 2545 g contre 278, 863, 1545 et 1910 g). Les gains de poids moyens quotidiens (DWG) entre 21-42, 42-70, 70-84, 42-84 et 21-84 jours ont été respectivement de (36.5, 35.8, 32.6, 34.8, et 35.1 g/j contre 27.6, 24.5, 25.7, 24.4 et 25.3 g/j) et les taux de mortalité (MP) dans les mêmes intervalles ont été respectivement de (3.3, 5.3, 2.8, 8.3, et 12 % contre 8.3, 13.5, 9.5, 24.2, et 34.7 %). Chez les croisés AN, comparés aux purs NN, on observe une légère baisse des performances LW (0-7.8%) et DWG (6.4-11.2%) alors que dans le groupe de croisés NA, comparé à AA, on note une remarquable augmentation de LW (6.8-25.7 %) et de DWG (20.3-34.3 %). Les effets d'hétérosis individuels, pour LW et DWG, ont été respectivement de 3.8-6.8 et 4.8-6.9. L'analyse de ces différences entre les groupes AN, NA et AA, sur LW, DWG et MP, permet de conclure à un effet pléiotropic du gène angora sur les performances de croissance et de viabilité. En ce qui concerne les caractéristiques bouchères, le poids du tractus gastrointestinal plein (FGTW), le poids de la carcasse de référence (RCW), le poids de la carcasse chaude (HCW), le rendement à l'abattage (DP), les poids de la tête (HW), des parties avant (FPW), des parties arrières (HPW) étaient significativement plus bas ($P<0.05$) chez les jeunes lapins AA comparés aux jeunes lapins NN, tandis que les poids de la peau (CSkW), des manchons (LgW) et du gras périrénal (PFaW) étaient significativement plus élevés ($P<0,05$). Comparés aux souches pures NN et AA, le rendement DP, les poids du foie (en % de RCW) et du gras périrénal (en % de RCW) étaient augmentés chez les croisés AN et NA, tandis que les parties arrières (en % de RCW) avaient tendance à décroitre à l'avantage des parties intermédiaires (en % de RCW)($P<0.05$). En ce qui conceme les qualités des carcasses, nous avons noté un effet hétérosis, respectivement, de 2.3, 10.4, et 25.0 % sur le rendement, le poids du foie et le gras périrénal.