PRODUCTION PERFORMANCE AND CARCASS TRAITS OF THREE RABBIT BREEDS REARED AT DIFFERENT TEMPERATURES

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ABSTRACT

The aim of the study was to investigate the effect of breed and ambient temperature on the production performance and carcass traits of growing rabbits. The experiment was conducted at the Kaposvár University and it considered the Pannon Ka (PKa), Pannon White (PW) and Pannon Large (PL) rabbits. Rabbits were housed in two identical rooms where the temperature was controlled using air conditioning. In the control room, the average ambient temperature was 20°C and in the other room it was 28°C. From 5 to 11 weeks of age, weaned rabbits (n= 60 rabbits/genotype/room) were housed in wire-mesh cages (3 rabbits/cage). Commercial pellets and water were available *ad libitum*. Individual body weights and feed intake per cage were recorded fortnightly and weight gain and feed conversion ratio were subsequently calculated. At the end of the experiment the rabbits were slaughtered and the carcass traits were evaluated. Overall, ambient temperature significantly influenced the production performance and carcass traits of growing rabbits. At high temperatures feed intake, weight gain and body weight decreased but feed conversion ratio improved. Concerning the productive performance, a clear tendency could be observed under control temperatures; the PL rabbits had the best and PKa breed the worst performances, while PW rabbits showed intermediate results (weight gain: 39.6 g/day, 45.9 g/day and 54.4 g/day; feed conversion ratio: 3.50, 3.11 and 2.91 in groups PKa, PW and PL respectively, $P<0.05$). At high temperatures PW rabbits had similar performances to the PKa rabbits. PL rabbits consumed more feed at both temperatures and their feed conversion ratio was better than the other two breeds (feed conversion ratio: 3.19, 3.01 and 2.65 in groups PKa, PW and PL respectively, $P<0.05$). At high temperatures the dressing percentage of the three breeds was higher than that recorded at normal temperature, and it was higher in PW rabbits than in other the two breeds (at 20°C: 60.4%, 61.2% and 60.6% and at 28°C: 61.1%, 62.4% and 61.2% in groups PKa, PW and PL respectively, $P<0.05$). The effects of breed and temperature on the three carcass parts were significant. At both temperatures, PKa rabbits had more perirenal and scapular fat than PL and PW rabbits (perirenal fat: at 20°C: 1.81%, 1.07% and 1.29% and at 28°C: 1.25%, 0.74% and 0.95% in groups PKa, PW and PL respectively, $P<0.05$). Significant breed x temperature interactions were also found and influenced the weight gain, feed conversion ratio, slaughter weight and chilled carcass weight. The results indicated that the three examined genotypes differ in adaptability regarding high ambient temperatures, which might be connected to the amount of fat deposits.

Key words: Growing rabbits, Production, Carcass traits, Temperature, Breed.

INTRODUCTION

Ambient temperature has a notable effect on the performance of growing rabbits. According to Marai *et al*. (2002), their optimal temperature range is 18-21°C and when temperatures are outside of this range, rabbits have to utilize energy to maintain the body temperature. When reared in high ambient temperatures rabbits consume less feed and as a consequence the weight gain, body weights and carcass weights decrease (Pla *et al*., 1994; Cervera *et al*., 1997; Ayyat and Marai, 1997).

The three rabbit breeds (Pannon Ka, Pannon White, Pannon Large) that are bred at Kaposvár University (Hungary) have differences in growth performance due to the different selection goals and procedures (Matics *et al*., 2014). Chiericato *et al.* (1993, 1996) found that crossbred rabbits reared at higher temperatures (Hyla and Provisal) had higher body weights at slaughter than the pure breed (New Zealand White); however, Zeferino *et al.* (2011) observed opposite tendencies with Botucatu (pure breed) and New Zealand White x Botucatu (cross breed) rabbits. The results show that rabbit breeds and lines may have different levels of adaptability to the heat stress conditions. Therefore, the aim of the study was to examine the production performance and carcass traits of three Hungarian rabbit breeds reared in different ambient temperatures.

MATERIALS AND METHODS

Animals and experimental design

The experiment was conducted at the Kaposvár University rabbit farm. Does and suckling kits were housed in commercial cages at 16-18°C ambient temperature. At weaning (5 weeks), rabbits from the three breeds were randomly divided into two groups and housed in two identical rooms. The rooms only differed regarding temperature: normal temperature (20°C) and high temperature (28°C). In each room, 60 growing rabbits per genotype (Pannon Ka /PKa/, Pannon White /PW/ and Pannon Large /PL/) were housed in commercial wire mesh cages (0.57 x 0.38 x 0.30 m; 3 rabbits/cage) and 16 hours light and 8 hours darkness lighting schedule was applied. Rabbits had *ad libitum* access to nipple drinkers and a commercial pelleted diet (5-9 weeks: DE: 9.94 MJ/kg; crude protein: 15.7%; crude fiber: 19%; medication; 9-11 weeks: DE: 10.6 MJ/kg; crude protein: 16.3%; crude fiber: 17.7% without medication).

Individual body weights (BW) and feed intake (FI) per cages were measured fortnightly. Subsequently, daily weight gain (DWG) and feed conversion ratio (FCR) were calculated. Mortalities were checked daily. At 11 weeks of age, the rabbits were transported to a slaughterhouse located 200 km from the rabbit farm, slaughtered (40 rabbits/breed/temperature) and dissected according to the WRSA recommendations (Blasco and Ouhayoun, 1996).

Statistical Analysis

Productive performance and slaughter traits were analyzed with multiway ANOVA (fix factors: temperature, breed) using R-project software. In case of temperature x breed interaction means were compared with one-way ANOVA.

RESULTS AND DISCUSSION

Both ambient temperature and breed had a significant effect ($P<0.001$) on the feed intake (Table 1). Breeds with higher body weights ingested more feed and the FI decreased in case of higher temperature. In regard to the effect of temperature, our results generally agreed with literature (Pla *et al*., 1994; Cervera *et al*., 1997; Ayyat and Marai, 1997). However, Chiericato *et al.* (1993, 1996) and Zeferino *et al.* (2011) did not find differences in FI for the examined genotypes.

The DWG of the rabbits was influenced by both the genotype and the temperature ($P<0.001$) and a genotype x temperature interaction was also found. Rabbits had lower BWG when reared in high temperatures, which is supported by literature (Pla *et al.*, 1994; Cervera *et al.*, 1997). The largest decrease was observed for the PW breed (-24%), while the PKa and PL rabbits had 19% lower BWG in 28°C than in 20°C. It seems that the adaptability to higher temperatures is less effective for PW than PKa and PL rabbits. These are opposing results to the study of Zeferino *et al.* (2011) who did not find differences in the BWG of pure breed and crossbred rabbits on higher temperature.

As a consequence of different BWG, the BW at 11 weeks was also influenced by the temperature and breed ($P<0.001$, Table 1). Compared to 20°C, at 28°C a larger decrease in BW was observed in PW rabbits than in PL or PKa rabbits (-16.5%, -13.9% and -12.5%, respectively). In the study of Chiericato *et al.* (1993, 1996), the BW of rabbits was also lower on high temperatures, the crossbred rabbits had higher BW than the pure breed and a temperature x genotype interaction was not detected.

Temperature and breed affected the FCR (P<0.001) and a significant temperature x genotype interaction (P=0.001) was found. Based on literature (Cervera *et al.*, 1997; Chiericato *et al.*, 1993, 1996), rabbits consume less feed at higher temperatures and display lower BW. These factors have a positive effect on feed utilization. This was also observed in the present work. During the whole growing period few or no mortalities were observed in the groups and it was not affected by the treatments.

Table 1: Effect of different ambient temperatures on the production performance of Pannon Ka (PKa), Pannon White (PW) and Pannon Large (PL) growing rabbits

	Genotype									
	PKa		**PW**		**PL**					
	Temperature							**Prob**.		
	20°C	**28°C**	**20°C**	**28°C**	**20°C**	**28°C**	**SE**	**Temp.**	**Genotype**	**T x G**
n	60	60	60	60	60	60	---	---	---	---
Feed intake (5-11 wk), g/day	138	103	143	105	161	121	1.99	<0.001	<0.001	0.283
Weight gain (5-11 wk), g/day	39.6^{b}	32.2^{a}	45.9^{c}	35.1^{a}	54.4^{d}	44.3^{c}	0.49	<0.001	<0.001	0.046
Body weight (5 wk), g	843	841	848	847	874	876	2.95	0.996	0.001	0.960
Body weight (11 wk), g	2504	2191	2779	2320	3146	2710	23.3	<0.001	<0.001	0.148
Feed conversion ratio (5-11 wk)	3.50^{e}	3.19^{d}	3.11^{cd}	3.01^{bc}	2.91^{b}	2.65^{a}	0.26	<0.001	<0.001	0.001
Mortality (5-11 wk),%	0.0	0.0	0.0	0.0	1.7	3.3		0.216		

^{a,b,c,d,e}: In case of interaction, different superscripts show significant difference between groups (P<0.05).

Table 2: Effect of different ambient temperatures on carcass traits of Pannon Ka (PKa), Pannon White (PW) and Pannon Large (PL) growing rabbits

	Genotype									
	PKa		**PW**		**PL**					
	Temperature							**Prob.**		
	20°C	**28°C**	**20°C**	**28°C**	**20°C**	**28°C**	**SE**	**Temperature**	**Genotype**	**T x G**
n	40	40	40	40	40	40	---	---	---	---
Slaughter weight, g	2504^{c}	2177^{a}	2778^{d}	2315^{b}	3197^{e}	2821^{d}	23.2	<0.001	<0.001	0.001
Chilled carcass weight, g	1514^{c}	1330^{a}	1698^{d}	1445^{b}	1937^{e}	1728^{d}	13.9	<0.001	<0.001	0.017
Dressing out (DoP),% CC	60.4	61.1	61.2	62.4	60.6	61.2	0.93	<0.001	<0.001	0.209
Ratios to reference carcass,%										
Fore part	29.8	29.3	28.9	28.6	29.8	29.8	0.06	0.029	0.001	0.255
Mid part	31.4	31.0	30.8	30.5	30.7	30.1	0.67	0.001	0.001	0.612
Hind part	36.4	38.0	38.8	39.9	37.7	38.8	0.92	<0.001	<0.001	0.179
Perirenal fat	1.81	1.25	1.07	0.74	1.29	0.95	0.31	<0.001	0.001	0.091
Scapular fat	0.58	0.41	0.32	0.23	0.46	0.34	0.14	0.001	0.001	0.429

^{a,b,c}: In case of interaction, different superscripts show significant difference between groups (P<0.05).

Coherent with the BW of rabbits at 11 weeks, differences were observed in the slaughter and chilled carcass weights (Table 2) according to the experimental group. The observed decrease with high ambient temperature was larger in PW than in PKa and PL rabbits. Both temperature and breed significantly affected the dressing out percentage (DoP). The PW rabbits, which have been selected for higher meat production since 1992, had the best DoP. All three breeds had favorable DoP when reared at high ambient temperatures, which is in accordance with the literature where the rabbits displayed 0.8% (Chiericato *et al.*, 1993) or 1.4% (Zeferino *et al.*, 2013) higher DoP when reared at 28-30°C than at 11-18°C. This can be explained by the lower feed intake and, as a consequence, a lighter digestive tract at higher ambient temperatures (Chiericato *et al.*, 1993). Zeferino *et al*. (2013) found that 1°C increment in temperature between 18 and 30°C means, on average, a 0.11% improvement in DoP.

The ratio of carcass parts and fat depots to reference carcass were influenced by temperature and breed, but not by their interaction. In general, the ratios of fore and mid parts were higher at 20°C, while the ratio of hind part was higher on 28°C. With higher ambient temperatures, the amount and ratio of perirenal and scapular fat depots decreased (P<0.01), the latter being coherent with the findings by Chiericato *et al.* (1996). The possible reason for these finding may be the lower feed intake of rabbits due to high temperatures. Regardless of the temperature, the highest fat ratio was observed in the PKa breed and the lowest in the PW genotype, while the PL rabbits had intermediate results. This is due to the selection for improving rabbi carcass meatiness, which resulted in lower fat deposits (Szendrő *et al*., 2012). This can also possibly explain the results of some other traits.

The greatest effect of higher temperatures was found in the PW genotype, which had lower fat deposits compared to the other two breeds. Hypothetically, the PKa and PL rabbits could mobilize more energy to cope with higher temperatures and lower feed intake.

CONCLUSIONS

The results indicated that the three examined breeds have differences regarding adaptability to the high ambient temperatures, which is possibly connected with the amount of fat deposits. The Pannon White breed displayed the lowest fat deposits and the high temperature exerted the greatest reduction in their production.

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REFERENCES

Ayyat M.S., Marai I.F.M. 1997. Effects of heat stress on growth, carcass traits and blood components of New Zealand White rabbits fed various dietary energy–fibre levels, under Egyptian conditions. *Journal of Arid Environments 37, 557–568.*

Blasco A., Ouhayoun J., 1996. Harmonization of criteria and terminology in rabbit meat research. Revised proposal. *World Rabbit Sci. 4, 93–99.*

Cervera C., Blas E., Fernández Carmona J. 1997. Growth of rabbits under different environmental temperatures using high fat diets. *World Rabbit Sci., 5, 71-75.*

Chiericato G.M., Rizzi C., Rostellato V. 1993: Effect of genotype and environmental temperature on the performance of the young meat rabbit. *World Rabbit Sci., 1 (3), 119-125.*

Chiericato G.M., Rizzi C., Rostellato V. 1996. Growth and slaughtering performance of three rabbit genotypes under different environmental conditions. *Ann. Zootech 45, 311-318.*

Marai. I.F.M., Habeeb A.A., Gad A.E. 2002. Rabbits' productive, reproductive and physiological performance traits as affected by temperature interaction effects on physiological responses and growth performance of rabbits. *Livest. Sci., 140, 177–183.*

Matics Zs., Nagy I., Gerencsér Zs., Radnai I., Gyovai P., Donkó T., Dalle Zotte A., Curik I., Szendrő Zs. 2014. Pannon Breeding Program in rabbit at Kaposvár University. *World Rabbit Sci., 22, 287-300.*

Pla M., Fernández-Carmona J., Blas E., Cervera C. 1994. Growth and some carcass traits of adult rabbits under high ambient temperature. *World Rabbit Sci. 2, 147–151.*

Szendrő Zs., Metzger Sz., Nagy I., Szabó A., Petrási Zs., Donkó T., Horn P. 2012. Effect of divergent selection for the computer tomography measured thigh muscle volume on productive and carcass traits of growing rabbits. *Livest. Sci., 149, 157-172.*

Zeferino C.P., Komiyama C.M., Fernandes S., Sartori J.R., Teixeira P.S.S., Moura A.S.A.M.T. 2013. Carcass and meat quality traits of rabbits under heat stress. *Animal, 7:3, 518-523.*

Zeferino C.P., Moura A.S.A.M.T., Fernandes S., Kanayama J.S., Scapinello C., Sartori J.R. 2011. Genetic group x ambient temperature interaction effects on physiological responses and growth performance of rabbits. *Livest. Sci., 140, 177–183.*