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A study on effect of floor pattern on meat qualities of New Zealand white rabbits

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Abstract
A study was conducted to evaluate the effect of housing on growth rate, carcass traits and meat quality of rabbits. Twenty four New Zealand White rabbits of both sexes (1:1) were weaned and selected at five weeks of age. The animals were randomly divided into two groups (T1 and T2) of 12 rabbits each with equal number from both sexes with an average uniform body weight. Rabbits in group T1 were housed in cages with steel floors and T2 with plastic slatted floors. The experiment was conducted during the post monsoon season for a period of nine weeks. The animals were slaughtered and meat qualities were observed for pH, Water Holding Capacity (WHC) (per cent), colour (l*a*b*), Warner - Bratzler Shear Force (WBSF) (N), collagen solubility (per cent of collagen), proximate composition (per cent of fresh weight) and sensory evaluation (8 point hedonic scale). There was significant difference (p<0.01) between T1 and T2 in WHC (18.717 ± 1.355, 29.218 ± 1.374, WBSF (35.714 ± 1.694, 19.612 ± 1.629), collagen solubility (30.91 ± 1.928, 38.26 ± 1.557) and fat content (p<0.05) (5.088 ± 0.783, 2.823 ± 0.314). There was no significant difference between T1 and T2 in pH (5.931 ± 0.013, 5.882 ± 0.022), colour (52.582 ± 1.252, 52.500 ± 0.797), protein (21.999 ± 0.583, 22.678 ± 0.219) and moisture content (71.545 ± 0.517, 72.136 ± 0.217). The sensory evaluation of cooked rabbit meat from T2 showed significantly higher score for appearance, tenderness, juiciness, flavor and overall acceptability than T1. The results indicated that rabbits reared on plastic slatted floors had better meat qualities and can be recommended to farmers for rearing rabbits.

Keywords: New zealand white rabbits, plastic slatted floor, meat quality, collagen solubility

1. Introduction
The rabbit is a versatile animal, and is found in virtually every country. But this species (*Oryctolagus cuniculus*) was domesticated rather recently as compared to other farm animals. Housing systems can affect meat quality and reproductive behaviour of rabbits. Housing systems with floor pens or colony cages seem to reduce stress and aggressive behaviour in animals but these systems increase mortality and decrease growth rates, feed intake, feed efficiency, and sometimes meat quality. Hence development of new housing systems and its evaluation is essential for improving the rabbit production. The present review aimed at different housing systems for domestic rabbits. For each housing systems, potential welfare issues are presented by comparing general husbandry practices to a definition of good rabbit welfare. It is concluded that welfare studies aimed at different housing systems for domestic rabbits have provided sufficient knowledge of the welfare effects of a rabbit's physical environment.

2. Materials and methods
2.1 Design of experiment
Twenty four New Zealand White rabbits of both sexes (1:1) were weaned and selected at five weeks of age. The animals were randomly divided into two groups (T1 and T2) of 12 rabbits each with equal number from both sexes with an average uniform body weight. The experiment was conducted during the post monsoon season for a period of nine weeks. The study was conducted at Rabbit Breeding Station under Centre for Advanced Studies in Animal Genetics and Breeding, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala. Rabbits were housed indoor in the same building supplied with enough ventilation system and natural lighting. The building consists of roof, floor and side wall made of concrete. All the animals were under uniform feeding regime as followed in the Rabbit Breeding Station, Mannuthy, Thrissur.
T1 - Rabbits housed in cages made with steel floors.

T2 - Rabbits housed in cages made with plastic slatted floors.
The animals were slaughtered and meat qualities were observed as per the recommendations of World Rabbit Science Association (WRSA) (Blasco and Ouhayoun, 1993) [2].
The parameters analyzed were:

a. pH
b. Water Holding Capacity (WHC)
c. Colour
d. Warner – Bratzler Shear Force (WBSF)
e. Collagen Solubility
f. Proximate composition
g. Sensory evaluation of cooked rabbit meat

2.2 Statistical analysis
Data recorded were analysed statistically as per Snedecor and Cochran (1994) by using SPSS Software Version 24.0.

3. Results and discussion
3.1 Physico – chemical properties of rabbits between T1 and T2
The data on physico - chemical properties such as pH, Water Holding Capacity (WHC), colour, Warner- Bratzler Shear Force (WBSF) and collagen solubility of rabbit meat are presented in table 1. The results showed that there was significant difference (p<0.01) between T1 and T2 in WHC (per cent) (18.717 ± 1.355, 29.218 ± 1.374), WBSF (N) (35.714 ± 1.694, 19.612 ± 1.629), collagen solubility (per cent of collagen) (30.91 ± 1.928, 38.26 ± 1.557) and no significant difference between T1 and T2 in pH (Initial- 6.677 ± 0.084, 6.709 ± 0.057) and colour (l*a*b*) (l*- 52.582 ± 1.252, 52.500 ± 0.797), (a*- 4.111 ± 0.539, 4.111 ± 0.539), (b*- 12.623 ± 0.593, 13.083 ± 0.632) of rabbit meat. The findings were similar to Trocino *et al.* (2002) [8] who found that increased water holding capacity corresponding to decreased loss of water throughout cooking and increased the force of cutting. Volek *et al.* (2018) [9] who reported that the shear force of eighty days old rabbit meat was 24.3 N and 21.3 N, respectively. The results of pH and colour were in accordance with Rodri´guez - calleja *et al.* (2004) [4] who found that pH of rabbit meat measured using a pH meter was 5.98. In the current study, a significantly different WHC between T1 and T2 was observed due to the higher moisture content in the T1 samples. The current study also revealed significantly higher collagen solubility for T2, which also could have contributed to the reduction in the shear force value.

Table 1: Physico – chemical properties of rabbit between T1 and T2 (Mean ± S.E.)

Parameter		T1	T2
pH	Ultimate (ns)	5.931 ± 0.013	5.882 ± 0.022
Water holding capacity (per cent) **		18.717 ± 1.355	29.218 ± 1.374
Colour (l*a*b*) (ns)	l	52.582 ± 1.252	52.500 ± 0.797
	a	4.111 ± 0.539	4.111 ± 0.539
	b	12.623 ± 0.593	13.083 ± 0.632
Warner- Bratzler Shear Force (N) **		35.714 ± 1.694	19.612 ± 1.629
Collagen Solubility (per cent of collagen) **		30.91 ± 1.928	38.26 ± 1.557

*p<0.05, **p<0.01, ns- non significant, n=12 for each treatment

3.2 Proximate composition of rabbit meat between T1 and T2
The data on proximate composition of rabbit meat is presented in table 2. The result showed that there was significant difference (p<0.05) between T1 and T2 in fat content (5.088 ± 0.783, 2.823 ± 0.314) and no significant difference in protein (21.999 ± 0.583, 22.678 ± 0.219) and moisture content (71.545 ± 0.517, 72.136 ± 0.217) of rabbit meat. Similar results were reported by Swami *et al.* (2014) who found that the moisture, protein and fat content of fresh rabbit meat were 72.83, 21.40 and 6.63 per cent, respectively. The significantly lower fat contents in T2 could be attributed to the new housing systems where animals are active and due to extra movements, it will give lean meat which is relatively low in fat content, which also implied a better rabbit welfare status.

Table 2: Proximate composition of rabbits between T1 and T2 (Mean ± S.E.)

Parameters (per cent of fresh weight)	T1	T2
Protein (ns)	21.999 ± 0.583	22.678 ± 0.219
Fat *	5.088 ± 0.783	2.823 ± 0.314
Moisture (ns)	71.545 ± 0.517	72.136 ± 0.217

*p<0.05, **p<0.01, ns- non significant, n=12 for each treatment

3.3 Sensory characteristics of cooked rabbit meat between T1 and T2
The cooked rabbit meat sensory characteristics of T1 and T2 were evaluated by a semi-trained taste panel using an 8-point hedonic scale. The results of the cooked rabbit meat taste-panel studies are presented in Table 3. The cooked rabbit meat sensory scores increased from T1 to T2. There was a highly significant difference (p<0.01) between T1 and T2 in appearance (6.988 ± 0.034, 7.398 ± 0.034), tenderness (6.964 ± 0.043, 7.313 ± 0.061), juiciness (6.946 ± 0.057, 7.392 ± 0.041), flavour (6.940 ± 0.043, 7.331 ± 0.040) and overall acceptability (6.982 ± 0.064, 7.404 ± 0.026) of rabbit meat. The results obtained were in accordance with reports of Ristic (1986) [3] who found that the composition and sensory quality of meat were mainly influenced by cross and sex. Warriss (2000) [10] observed that juiciness could be affected by water holding capacity, and panelist findings regarding juiciness was often related with scores for tenderness. Smith (2005) [5] showed that most of the flavour precursors are present in the lipid component of meat. Bailey and Light (1989) [1] found that principal constituent of the connective tissue was collagen. Tenderness not only depends on the collagen content but also on its per cent of soluble collagen.

Table 3: Sensory characteristics of cooked rabbit meat between T1 and T2 (Mean ± S.E.)

Parameter (8 point Hedonic scale)	T1	T2
Appearance **	6.988 ± 0.034	7.398 ± 0.034
Tenderness **	6.964 ± 0.043	7.313 ± 0.061
Juiciness **	6.946 ± 0.057	7.392 ± 0.041
Flavour **	6.940 ± 0.043	7.331 ± 0.040
Overall acceptability **	6.982 ± 0.064	7.404 ± 0.026

*p<0.05, **p<0.01, ns- non significant, n=12 for each treatment

4. Conclusion

The results obtained showed a clear advantage for the rabbits for plastic slat floor compared to stainless steel floors. Treatment had significant effect on meat quality of rabbits housed in plastic slatted floors. Cost of plastic slatted floors are higher but the durability is better compared to steel floors. So this type of housing systems can be recommended to farmers for rearing rabbits.

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