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Effect of genotype, housing system and hay supplementation on carcass traits and meat quality of growing rabbits

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ABSTRACT

The aim of the study was to examine the effects of genotype (Pannon Large × Pannon Ka/Large/or Hungarian Giant × Pannon Ka/Hung), housing system (Cage or small Pen) and hay supplementation (Pellet without or with Hay/P + Hay/) on carcass and meat (*Longissimus dorsi*/LD/ and hind leg/HL/) quality of growing rabbits. Large rabbits showed higher carcass weights, as well as higher fatness and meatiness compared to Hung rabbits. Caged rabbits were heavier, with higher prevalence of the mid part of the carcass, and showed higher fatness and lower meat toughness than Penned rabbits. Caged rabbits meat was richer in MUFA, but poorer in PUFA and Σ *n*−6 FA. Hay supplementation impaired carcass weight, carcass fatness, L* and a* color, and lipids content. P + Hay increased the HL meat content of C18:3 *n*−6 and C20:5 *n*−3 FA. Overall results offer further information on how alternative breeds, housing systems and feeding strategies can affect carcass traits and meat quality.

1. Introduction

In addition to rabbit meat products from intensive systems, there is a growing interest in meats originating from less intensive breeds kept in alternative housing and feeding conditions (Dalle Zotte & Paci, 2014). This has led to the development of various alternative production systems.

Most countries have one or more local breeds that play significant roles in commercial production. One such breed is the Giant rabbit, which can be used either as pet rabbit or terminal breed. Whereas several papers have been published on the carcass traits of Flemish Giant (Lukefahr, Hohenboken, Cheeke, Patton, & Kenninck, 1982; Ozimba & Lukefahr, 1991; Prayaga & Eady, 2003;), Spanish Giant (López & Sierra, 2002), German Giant (Bianospino, Wechsler, Fernandes, Roça, & Moura, 2006), Moravian Blue (Tůmová et al., 2013), and Hungarian Giant (Holdas & Szendrő, 2002), only few have investigated their meat quality (Bolet, 2002; Maj, Bieniek, Sternstein, Węglarz, & Zapletal, 2012).

The effect of housing condition on carcass traits and meat quality has been summarized by Szendrő and Dalle Zotte (2011). Most studies showed that increasing group size led to lower dressing out percentage, fore part to reference carcass, meat to bones and fat depot ratios but higher hind part weight, while the mid part ratio remained the same (Dal Bosco, Castellini, & Mugnai, 2002; Dalle Zotte et al., 2009; Combes, Postollec, Cauquil, & Gidenne, 2010).

In nutrition, one alternative method consists in adding fresh or dried forage to pelleted diets (Carabaño & Fraga, 1991). Scientists have tested several forages: dehydrated alfalfa on carcass traits and meat quality (Bianchi, Petracci, & Cavani, 2006), fresh alfalfa on carcass traits and fatty acid (FA) profile (Capra et al., 2013), or on FA profile (Dal Bosco et al., 2014), and green barley on dressing out percentage (Morales, Fuente, Juárez, & Ávila, 2009).

In most of the experiments, the effect of each factor was investigated separately. The aim of the current study was to examine both the separate and combined effects of genotype, housing system, and hay supplementation on carcass traits and meat quality of growing rabbits.

2. Material and methods

The study was approved by the Ethical Committee for Animal Experimentation of Kaposvár University. The experiment was carried out at Kaposvár University. Pannon Ka (maternal line of the Pannon Breeding Program) females were inseminated with pooled and diluted semen of Pannon Large (terminal line of the Pannon Breeding Program, hereafter Large) or Hungarian Giant (Hung) males. The Large rabbits were selected for daily weight gain and hind leg muscle volume based on computer tomography (CT) data (Matics et al., 2014). Hung rabbit semen was obtained from a private breeder. Hungarian Giant is a traditional breed in Hungary that originated from a native colored

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population that was crossed with Flemish Giant and other giant breeds (Holdas & Szendrő, 2002). Some breeders also use some intensive breeds now to improve performance, however.

The Large and Hung rabbits (n = 336) were weaned at 5 weeks of age; one half was kept in cages (61 × 32 cm, 3 rabbits/cage), the other half in small open top pens (190 × 50 cm, 14 rabbits/pen). In both cases, the floors were wire-mesh, without elevated platform, and the stocking density was 16 rabbits/m^2. Two subgroups were formed: rabbits receiving only commercial pellet and rabbits fed commercial pellet plus grass hay, ad libitum. The design of the experiment is shown in Fig. 1.

Water was available ad libitum from nipple drinkers. The room temperature was 15–17 °C, and the daily lighting period was 16 h. Live performances of rabbits have been reported elsewhere (Szendrő et al., 2015).

At 12 weeks of age, rabbits (n = 287) were transported to a slaughterhouse located 200 km from the experimental farm. Fasting time was 6 h, including the 4 h for transportation. Slaughter and carcass dissection procedures were performed using recommendations of the World Rabbit Science Association (WRSA) described by Blasco and Ouhayoun (1996). Rabbits were slaughtered by cutting the carotid arteries and jugular veins after electro-stunning. The slaughtered rabbits were bled, and then the skin, genitals, urinary bladder, gastrointestinal tract, and the distal part of legs were removed. Hot carcasses (with head, set of organs /consisting of thymus, trachea, esophagus, lung and heart/, liver, kidneys, and perirenal and scapular fat) were weighed, then chilled at +4 °C for 24 h. The chilled carcasses (CC) were then weighed. The head, set of organs, liver, and kidneys were removed from each carcass to obtain the reference carcass (RC), which included the meat, bones, and fat deposits. The carcasses were then cut between the 7th and 8th thoracic vertebra and between the 6th and 7th lumbar vertebra to obtain the fore, mid, and hind parts, which were weighed separately. The dressing out percentage (DoP: CC weight divided by slaughter weight /SW/ and multiplied by 100) and the ratio of the organs and carcass parts to either SW or RC weight were calculated as required. Subsequently, the *Longissimus dorsi* (LD) muscle and hind legs (HL) were dissected from all animals and then weighed.

Chemical compositions of diets were shown by Szendrő et al. (2015), and FA compositions of pellet and hay are presented in Table 1. Lipid extraction and fatty acid methyl esters (FAME) determination of the experimental diets was performed according to Dalle Zotte et al. (2014).

Table 1
Fatty acid composition of pelleted diets and hay.

Fatty acid profile	Pelleted diet	Grass hay
C10:0	0.10	0.13
C12:0	0.07	0.27
C14:0	0.27	0.68
C14:1	0.04	0.20
C15:0	0.07	0.52
C15:1	0.07	0.22
C16:0	12.9	18.8
C16:1	0.23	0.39
C17:0	0.14	0.38
C17:1	0.06	0.07
C18:0	3.10	9.21
C18:1 *n*−9 (oleic)	27.6	8.32
C18:1 *n*−11 (trans vaccenic)	0.80	0.86
C18:2 *ct n*−6 (linoleic)	46.5	30.4
C18:3 *n*−6 (γ-linolenic)	0.00	0.07
C18:3 *n*−3 (α-linolenic)	4.08	14.7
C18:2 c9-t11	0.14	0.12
C20:0	0.22	0.70
C20:1 *n*−9	0.00	0.00
C20:2	0.00	0.20
C20:3 *n*−6	0.22	0.31
C20:4 *n*−6 (arachidonic)	0.00	0.07
C20:3 *n*−3	0.00	0.21
C20:5 *n*−3 (EPA)	0.09	0.25
C23:0	0.10	0.34
C22:6 *n*−3 (DHA)	0.03	0.08
SFA	17.0	31.0
MUFA	28.8	10.1
PUFA	51.1	46.4
UFA/SFA	4.72	1.82
Σ *n*−6	46.8	30.9
Σ *n*−3	4.20	15.26
n−6/*n*−3	11.13	2.02

2.1. Rabbit meat rheological and chemical analyses, lipid extraction and FA determination

A total of n = 120 LD and HL were used for pH and color measurements. The pH was measured 24 h *post mortem* (ultimate pH or pHu) at the 5th lumbar vertebra level of the LD, whereas HL pHu was measured at the *Biceps femoris* level. L*a*b* color values were recorded on a cross-section of the fresh surface of mid-LD between the 6th and 7th lumbar vertebrae. Both LD and HL cuts were then individually packed and frozen at −80 °C until further analysis.

LD and HL cuts were allowed to thaw overnight at +4 °C and weighed again for thawing loss measurement. Afterwards, n = 80 LD were individually vacuum-sealed in cooking PVC bags and cooked in a water bath at 80 °C for 1 h. Each sample was chilled with cold tap water, removed from its PVC bag, dried, and weighed for cooking loss determination. Cooked LD were used for Warner–Bratzler Shear Force (WBSF) measurements on cores (diameter 1.25 cm) sheared perpendicularly to muscle fiber direction with a Warner–Bratzler cell fitted

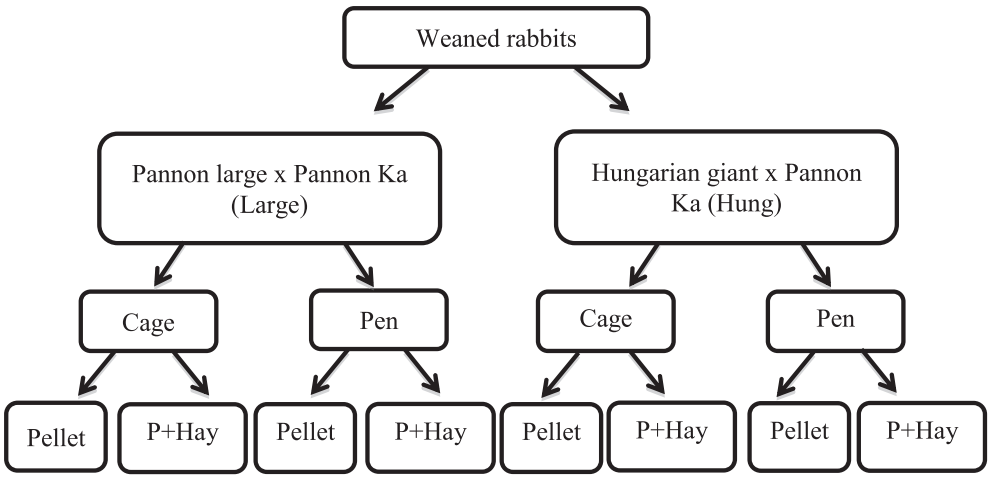

Fig. 1. Experimental design.