Annals of Agric. Sci., Moshtohor **ISSN 1110-0419**
Vol. 60(4) (2022), 1103 – 1110 **https://assjm.journals.ekb.eg**

Influence of Weaning Age and Housing System on Carcass Traits and Meat Quality of V-Line and Moshtohor Rabbits

R.A. Abou-Saleh, A. S. M. Soliman, M. R. El-Mahdy and T. M. M. Hassan*
Department of Animal Production, Faculty of Agriculture, Benha University, Egypt
***Corresponding author:** tamer.mohamed@fagr.bu.edu.eg

Abstract

The aims of this study was to investigate the influence of rabbits breed (Moshtohor and V-line), weaning age (28 and 35 days) and housing system (cages and floor type) on carcass traits and meat quality by using 120 male rabbits divided into two breed groups (60 Moshtohor rabbits and 60 V-line rabbits) each breed divided into two weaning groups (30 rabbits weaned at 28 days and 30 rabbits weaned at 35 days) each weaning group divided into two housing systems groups (15 rabbits raised in cages and 15 rabbits raised in floor). All experimental rabbits were fed concentrate feed mixture according to National Research Council, **NRC (2004)** recommendation based on the rabbits live body weight. Diets were offered twice daily in equal quantities at 8:00 and 16:00 and estimated for each group every day. Both of the consumed diets and refusals if any were recorded daily. All rabbits in each group individually weekly weighed from 5 to 13 weeks of age. Three rabbits from each group were randomly chosen at the end of the experimental period for slaughter test. Results showed that Moshtohor rabbits weaned at 35 days of age reared in cages had a higher carcass traits and meat quality than the other ones. Thus, we can concluded and recommended from this results that rabbits breeders can using Moshtohor rabbits, reared in cages and weaned at 35 days of age to earn the highest carcass traits and meat quality.

Keywords*:* weaning age, housing system, Moshtohor Rabbits, carcass traits, meat quality

Introduction

The rabbits breeding are one of the most successful investment projects, especially in recent years because rabbits are characterized by abundant production and rapid growth that are not available in other animals. The importance of rabbits at the national level may due to solve the problem of the deficits in animal protein (**Eman, 2019**). Rabbits can play a significant role in solving the problem of meat shortage in many parts of the world, due to their high potential for reproduction, rapid growth rate, short generation interval, ample nutritional spectrum, limited vital space and ease of rearing. However, pre- and post-weaning mortality until marketing limits the crop of rabbits in kilograms and a lower income would be obtained. **(Rashwan and Marai, 2000).** As a result of many years of domestication and crossbreeding, a wide variety of rabbit breeds exist today. Accordingly, a new Egyptian line of rabbits called Moshtohor (M-line) was synthesized, which considered as a synthetic multi-purpose line **(Iraqi *et al.*, 2010)**. This line resulted from crossing Egyptian Sinai Gabali bucks with Spanish V-line does, where selection was practiced on the crossbreds for litter weight at weaning and live weight at 56 days **(Iraqi *et al.*, 2007)**. These studies were based on evidence stating that Spanish V-line rabbits and their crosses could produce and reproduce efficiently under hot climatic conditions **(Khalil *et al.*, 2005; Iraqi *et al.*, 2010).** This study conducted to investigate the weaning age (traditional and late weaning) and housing systems (floor and hatches type) of two rabbit breeds (V-Line and Moshtohor rabbits) on carcass traits and meat quality.

Materials and Methods

The experimental work of this study was carried out at a private rabbits farm under supervision of Benha University Animal Production Professors duration time from 15 January to 18 March 2020.

Management of experimental animals:

A total of 120 male rabbits (60 V-Line and 60 Moshtohor) were divided into two weaning age (each group contains 30 rabbits). First group weaned at 28 days of age (traditional weaning) and the second group weaned at 35 days of age (late weaning) according to **Apter and Householder (1996)**, each group divided into two housing system (each group contains 15 rabbits). First group reared in a floor house and the second group reared in hatches. At floor housing system, each 5 rabbits were kept in wires folding house (length 150 cm, wide 100 cm, and height 60 cm), which provided with fed and drinking equipment, wheat straw litter. There was an inclination in the floor 5 cm to the sewage drain according to **Stewart and Suckow (2016).** At the hatches housing system, each 5 rabbits were kept in hatch house (with length 50 cm, wide 50 cm and height 50 cm), and was provided with fed and drinking equipment. The hatches were higher on the floor by 150 cm according to **Dal Bosco *et al.* (2002).**

DOI: 10.21608/ASSJM.2023.279107

Experimental diet:

All experimental rabbits were fed concentrate feed mixture according to National Research Council, **NRC (2004)** recommendation based on the rabbits live body weight and the ingredients and chemical analysis of the ration used in the rabbits feeding showed in Table1.

Table 1. Ingredients and Chemical analysis of the ration used in rabbits feeding.

Item	Composition on DM basis %				
	CP	CF	EE	NFE	Ash
Concentrate feed mixture (CFM)*	18.00	13.60	2.80	58.72	6.88

*CFM consisted of Hay 30 %, Barley 9 %, corn Yellow 15 %, wheat bran 30 %, soybean meal 14 %, and add nitration 2 %.

Rabbits carcass characteristics:

Three rabbits from each group were randomly chosen at the end of the experimental period for slaughter test. These rabbits were 13 weeks of age and the averages in body weights of all groups were nearly similar (were of about the same averages). Live condition scores (LCS) of rabbits (1weak, 2acceptable, 3good, 4very good and 5excellent) were recorded according to **Armero and Blasco (1992).** Samples of studied rabbits were slaughtered to determine its carcass characteristics. They were fasted for approximately 16 hours, according to **El-Sayaad and Abd EL-Rahman (1990)** then were weighted individually to obtain pre-slaughter weight (fasted weight) and slaughtered by severing the neck with a sharp knife according to Islamic Religion. The slaughter weight was recorded after complete bleeding. The head was separated and the body was skinned. Skinning was carried out by removing the skin, including the tail and feet, then after the carcass was opened all internal organs were removed. Also, lungs, liver, kidneys and heart were weighed. The weights of the carcass, fur, head and legs were recorded. The carcass for each rabbit was separated into front quarter, chest, loin and hindquarters and their weights were also recorded according to **Cheeke (1987)**. All weights were taken to the nearest gram and related to the fasted weight. Dressing percentage was calculated using the following equation:

$$\text{Dressing percentage \%} = \frac{\text{Dressed weight (g)}}{\text{Fasted weight (g)}} x100$$

Meat of Longissimus dorsi (eye muscle) for each carcass was separated from the bones and weighted, minced, dried, re-weighed, ground and stored at 10◦ C for physical (PH, tenderness and water holing capacity) and chemical analysis according to **AOAC (2004).**

Statistical analysis:

Statistical analysis was carried out by using the least squares procedure for analyzing the data with unequal subclass number described by **SAS (2004)**. The Statistical model used may be written as follows:

$$Y_{ijkl} = \mu + B_i + W_j + H_k + (BW)_{ij} + (BH)_{ik} + (WH)_{jk} + e_{ijkl}$$

Where: Y_{ijkl} =the observation of carcass traits and blood metabolites for ijk rabbit; μ= general mean, common element to all observations; B_i= the fixed effect due to I^{th} breed group (i=1, 2); W_j =the fixed effect due to the j^{th} weaning age (j=1,2); H_k =the fixed effect due to the k^{th} housing system (j=1,2); $(BW)_{ij}$= the fixed effect of the interaction between breed and weaning age; $(BH)_{ik}$= the fixed effect of the interaction between breed and housing system; $(WH)_{jk}$= the fixed effect of the interaction between weaning age and housing system; E_{ijkl}= random error associated with the individual observation and assumed (NI D). Tests of significance for differences between means were carried out according to **Duncan (1955).**

Results and Discussion

Rabbit's carcass traits:

M-line rabbits showed higher carcass traits (fasted weight g, live conditions score, carcass weight g and dressing %) of experimental rabbits, than V-line rabbits. The differences between means for carcass traits, due to breed (M-line, V-line) effect was not significant, as showed in Table 2. Similar results observed by **Fathi *et al.* (2017)** who showed that carcass weight and dressing percent of V-line and Gabali local rabbits slaughtered at 16 weeks of age; carcass weight was 895.06 and 1158.78 grams; dressing percent was 47.95 and 55.39 %, respectively and the differences between means of rabbit's carcass weight and dressing percent, due to breed effect was significant (P<0.001), **Belabbas *et al.* (2019)** who noticed that hot carcass weight of local Algerian and synthetic line of rabbits slaughtered at 91 days of age was 1454 and 1716 grams, while, dressing percent was 67.10 and 68.05%, respectively and the differences between means of rabbit's hot carcass weight, due to breed effect was significant (P<0.01) except for dressing percent. The differences between means for carcass traits (fasted weight g, live condition score, carcass weight g), due to weaning age effect was not significant except for dressing percentage (P<0.05). Rabbits weaned at 35 days of age resulted higher dressing % than rabbits weaned at 28 days of age, as showed in Table 2. The finding is in agreement with **Marongiu *et al.* (2006)** who working on crossbred rabbits (New Zealand White x Californian), concluded that rabbits

slaughtered at 83 days of age hot carcass weight was 1294 and 950 grams, while, dressing percent was 59.71 and 51.71%, for rabbits weaned at 28 and 63 days, respectively and the differences between means of rabbits hot carcass weight and dressing percent, due to weaning age effect was significant (P<0.05). Also**, Zita *et al.* (2012)** who concluded that hot carcass weight and dressing percent of HYLA rabbits slaughtered at 77 days of age were 1811.7 grams and 58.7%, for rabbits weaned at 21 days of age while, it were 1782.5 grams and 57.8%, for rabbits weaned at 35 days of age, respectively and the differences between means of rabbits hot carcass weight, due to weaning age effect was significant (P<0.05) except for dressing percent. The differences between means for carcass traits (Fasted weight, g and carcass weight, g), due to housing system effect were not significant except for live conditions score and dressing percentage% (P‹0.05). Rabbits housed on floor showed higher live conditions score and dressing percentage%, than rabbits housed in cages as showed in Table 2. The finding is in agreement with **Pinheiro *et al.* (2011)** who found that hot carcass weight and dressing percent of crossbred rabbits (New Zealand White×Californian) slaughtered at 87 days of age was 1647 grams and 59.9%, for rabbits housed in open air, while it was 1901 grams and 60.7%, for rabbits housed in cages, respectively and the differences between means of rabbit's hot carcass weight, due to housing system effect was significant (P<0.05) except for dressing percent, **Chodova *et al.* (2014)** who obtained that dressing percent and carcass weight of Czech rabbits kept on a different housing systems (cages or floor pens) was affected significantly (P<0.05) by rabbits housing system, **Matics *et al.* (2019)** who reported that carcass weight of Pannon Ka growing rabbits slaughtered at 11 weeks of age was 1514 and 1450 grams, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbit's carcass weight, due to housing system effect was significant (P<0.01). The differences between means for carcass traits (Fasted weight, g and carcass weight, g), due to housing system effect were not significant except for live conditions score and dressing percentage% (P‹0.05). Rabbits housed on floor showed higher live conditions score and dressing %, than rabbits housed in cages as showed in Table 2. The finding is in agreement with **Pinheiro *et al.* (2011)** who found that hot carcass weight and dressing percent of crossbred rabbits (New Zealand White × Californian) slaughtered at 87 days of age was 1647 grams and 59.9%, for rabbits housed in open air, while it was 1901 grams and 60.7%, for rabbits housed in cages, respectively and the differences between means of rabbit's hot carcass weight, due to housing system effect was significant (P<0.05) except for dressing percent, **Chodova *et al.* (2014)** who obtained that dressing percent and carcass weight of Czech rabbits kept on a different housing systems (cages or floor pens) was affected significantly (P<0.05) by rabbits housing system, **Matics *et al.* (2019)** who reported that carcass weight of Pannon Ka growing rabbits slaughtered at 11 weeks of age was 1514 and 1450 grams, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbit's carcass weight, due to housing system effect was significant (P<0.01).

The differences between means for internal organs and carcass cuts weight of experimental rabbits, due to breed (M-line, V-line) effect was not significant. M-line rabbits showed higher internal organs and carcass cuts weight of experimental rabbits except for heart and spleen weight, than V-line rabbits as showed in Table 2. The finding is in agreement with **Fathi *et al.* (2017)** who obtained that internal organs and carcass cuts weight of V-line and Gabali local rabbits slaughtered at 16 weeks of age, the differences between means of rabbit's offal's weight, due to breed effect was not significant. On contrary, **El -Sheikh *et al.* (2011)** who resulted that offal's weight of New-Zealand White, V-line, Baladi Black and Gabli rabbits slaughtered at 60 days of age; liver weight was 41.29, 52.74, 47.31 and 36.46 grams; heart weight was 6.87, 7.31, 7.12 and 6.52 grams, respectively and the differences between means of rabbits offal's weight, due to breed effect was significant (P<0.05), **Dalle Zotte *et al.* (2015)** who observed that internal organs of Pannon Large and Hungarian Gaint rabbits slaughtered at 12 weeks of age; head was 5.05 and 5.35%; lung and heart was 0.76 and 0.79%; liver was 2.81 and 2.64%; kidneys was 0.59 and 0.64%; fore part of carcass was 27.5 and 27.1%; hind part of carcass was 36.9 and 37.3%, respectively and the differences between means of rabbit's internal organs and carcass cuts, due to breed effect was significant (P<0.01). Rabbits weaned at 28 days of age resulted higher for internal organs and carcass cuts weight of experimental rabbits, except for (liver, round and chest), than rabbits weaned at 35 days of age. The differences between means for internal organs and carcass cuts weight of experimental rabbits, due to weaning age effect was not significant except for spleen weight (P‹0.05) as showed in Table 2. The finding is in agreement with **Marongiu *et al.* (2006)** who working on crossbred rabbits (New Zealand White x Californian), observed that rabbits slaughtered at 83 days of age internal organs percent (head, skin, lung and heart) was 5.19, 13.13, 6.85 and 2.95%, for rabbit weaned at 28 days of age, while, it was 6.94, 14.87, 7.93 and 3.96%, for rabbits weaned at 63 days of age, respectively and the differences between means of rabbits internal organs percent, due to weaning age effect was significant (P<0.05), **Zita *et al.* (2012)** who concluded that liver percent of HYLA rabbits slaughtered at 77 days of age were 5.9 and 5.2%, for rabbits weaned at 21 and 35 days of age, respectively and the differences between means of rabbits liver

percent, due to weaning age effect was significant (P<0.05). The differences between means for internal organs and carcass cuts weight of experimental rabbits, due to housing system effect was significant (P‹0.05) except for heart and loin weight of experimental rabbits. Rabbits housed on floor showed higher internal organs and carcass cuts weight except for liver weight than rabbits housed in cages as showed in Table 2. The finding is in agreement with **Loponte *et al.* (2018)** showed that carcass offal's weight of California × New Zealand White rabbits who slaughtered at 99 days of age; heart weight was1.76 and 1.98 %; liver weight was 4.66 and 5.76%; spleen weight was 0.18 and 0.19%, for rabbits housed in cages and free range, respectively and the differences between means of rabbit's carcass internal organs weight, due to housing system effect was not significant except for liver weight (P<0.05), **Matics *et al.* (2019)** who reported that internal organs and offal's weight of Pannon Ka growing rabbits slaughtered at 11 weeks of age; liver weight was 72.00 and 72.70 grams; kidneys weight was 17.00 and 17.00 grams; head weight was 124 and 125 grams; hind legs weight was 435 and 418 grams, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbit's internal organs weight, due to housing system effect was not significant except for hind legs weight (P<0.01).

The differences between means for carcass offal´s weight of experimental rabbits (Fur, Legs, Head, Digestion Tract, lung, Kidneys), due to breed (M-line, V-line) effect was not significant. M-line rabbits had a higher carcass offal´s weight of experimental rabbits except (fur and legs), than V-line rabbits, as showed in Table 2. These results disagree with **Fathi *et al.* (2017)** who obtained that offal's weight (skin, head, liver heart and kidneys) of V-line and Gabali local rabbits slaughtered at 16 weeks of age, the differences between means of rabbit's offal's weight, due to breed effect was not significant. On contrary, **El -Sheikh *et al.* (2011)** who resulted that offal's weight of New-Zealand White, V-line, Baladi Black and Gabli rabbits slaughtered at 60 days of age; kidneys weight was 11.27, 13.72, 12.58 and 10.14 grams; lungs weight was 8.22, 9.81, 9.37 and 7.83 grams, respectively and the differences between means of rabbits offal's weight, due to breed effect was significant (P<0.05). Rabbits weaned at 28 days of age resulted higher for carcass offal´s weight of experimental rabbits (fur, legs, head, digestion tract and lung), except for kidneys weight, than rabbits weaned at 35 days of age. The differences between means for carcass offal´s weight of experimental rabbits (fur, legs, head and kidneys), due to weaning age effect was not significant except for lung and digestion tract weight (P‹0.05), as showed in Table 2. The finding is in disagreement with **Dalle Zotte *et al.* (2015), Marongiu *et al.* (2006)** and **Zita *et al.* (2012).** The differences between means for carcass offal´s weight of experimental rabbits (Fur, Head, lung and kidneys), due to housing system effect was not significant except for legs and digestion tract weight (P‹0.05) and it was higher in rabbits housed on floor than rabbits housed in cages, as showed in Table 2. The finding is in agreement with **Belabbas *et al.* (2019), Pinheiro *et al.* (2011) and Xiccato *et al.* (2013).** The differences among means of carcass traits, due to the interaction among rabbits breed, weaning age and housing system, were not significant.

Table2. Effect of weaning age, housing system on carcass traits of Moshtohor and V-line rabbits.

Items	Breed		Weaning age		Housing system		±SEM
	M	V-line	28 days	35 days	Cages	Floor	
Fasted weight, g	2145	2120	2086	2180	2146	2119	68.50
Live condition score	3.5	3.2	3.7	3.0	3.7	3.0	0.20
Hot carcass weight, g	1312	1272	1213	1369	1327	1208	58.00
Dressing percentage, %	61	60	58[b]	60[a]	62[a]	56[b]	1.00
Heart weight, g	7.3	7.5	7.8	7.0	7.1	7.6	0.54
Spleen weight, g	7.8	7.8	9.0[a]	6.7[b]	7.3[b]	8.3[a]	0.45
Liver weight, g	80.0	79.0	76.3	83.0	83.0[a]	76.0[b]	0.34
Round weight, g	393	389	366	417	351[a]	331[b]	14.0
Loin weight, g	289	282	280	291	288	283	14.6
Chest weight,	240	224	207	258	241[a]	223[b]	14.6
Front quarter weight, g	391	377	362	406	447[a]	371[b]	20.6
Fur weight, g	251	279	278	255	268	262	13.3
Legs weight, g	76	83	83	76	76	83	3.28
Head weight, g	117	114	116	114	117	114	3.05
Lung weight, g	19	17	21	17	18	20	1.37
Kidneys weight, g	19	18	18	19	18	19	1.12

[a, b] Means within any classification, followed by different letters are significantly different (P<0.05).

Rabbit's meat quality:

M-line rabbits showed higher for tenderness and water holding capacity (WHC), than V-line rabbits,

but, V-line rabbits were higher for pH value. The differences between means for meat physical analysis of experimental rabbits, due to breed (M-line, V-line) effect was significant (P‹0.05), except for pH value, as showed in Table 3. The finding is in agreement with **Larzule *et al.* (2005)** who revealed that meat pH value of three lines of rabbits (L, H and C line) was5.78, 5.83 and 5.69, respectively and the differences between means of rabbits skin percent, due to breed effect was not significant. Also, **Dalle Zotte *et al.* (2015)** who observed that meat pH value of Pannon Large and Hungarian Gaint rabbits slaughtered at 12 weeks of age was 6.09 and 6.15, while, water holding capacity (WHC) was 3.19 and 3.16, respectively and the differences between means of rabbit's meat pH value and WHC, due to breed effect was not significant, **Belabbas *et al.* (2019)** who noticed that meat pH value of local Algerian and synthetic line of rabbits slaughtered at 91 days of age was 5.61 and 5.63, respectively and the differences between means of rabbit's meat pH value, due to breed effect was not significant. The differences between means of the meat physical analysis of experimental rabbits, due to weaning effect were significant (P‹0.05). Rabbits weaned at 35 days of age had higher tenderness and WHC than rabbits weaned at 28 days of age, while, rabbits weaned at 28days of age had higher pH-value than rabbits weaned at 35 days of age, as showed in Table 3. The finding is in agreement with **Bivolarski *et al.* (2011)** who found that meat water holding capacity (WHC) of New Zealand White rabbits slaughtered at 90 days of age was 33.04 and 16.89%, while, pH-value was 5.49 and 5.77, for rabbits weaned at 21 and 35 days of age, respectively and the differences between means of meat WHC and pH value, due to weaning age effect was significant (P<0.05). The differences between means the meat physical analysis of experimental rabbits, due to housing system effect was significant (P‹0.05) for WHC while, it was not significant for tenderness and pH-value. Rabbits housed on floor showed higher tenderness and WHC, than rabbits housed in cages, as showed in Table 3. The finding is in agreement with **Xiccato *et al.* (2013)** who obtained that meat pH value of Hyplus crossbred line rabbits slaughtered at 76 days of age was 5.71 and 5.71, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbit's meat pH value, due to housing system effect was not significant, **Dalle Zotte *et al.* (2015)** who observed that meat pH value of Pannon Large and Hungarian Gaint rabbits slaughtered at 12 weeks of age was 6.13 and 6.12, while, water holding capacity (WHC) was 2.58 and 3.77, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbit's meat pH value and WHC, due to housing system effect was not significant. Also**, Matics *et al.* (2019)** who reported that meat pH value of Pannon Ka growing rabbits slaughtered at 11 weeks of age was 6.09 and 6.15, for rabbits housed in cages and floor pens, respectively and the differences between means of meat pH value, due to housing system effect were not significant.

The differences between means for meat chemical analysis of experimental rabbits, due to breed (M-line, V-line) effect were significant (P‹0.05), except for moisture and protein%. M-line rabbits showed higher meat chemical analysis than V-line rabbits except for fat%, as showed in Table 3. The finding is in agreement with **Fathi *et al.* (2017)** who showed that meat chemical analysis of V-line and Gabali local rabbits slaughtered at 16 weeks of age; moisture was 75.58 and 74.55 %; protein was 21.63 and 22.44 %; fat was 1.65 and 1.81%; ash was 1.14 and 1.20%, respectively and the differences between means of rabbit's meat moisture and ash percent, due to breed effect was significant (P<0.05). **Belabbas *et al.* (2019)** noticed that meat moisture, protein, ether extract and ash percent of rabbits slaughtered at 91 days of age was 62.33, 22.02, 2.22 and 1.86%, for local Algerian rabbits, while, it was 68.81, 18.98, 3.41 and 1.92%, for synthetic line rabbits, respectively and the differences between means of rabbit's meat chemical analysis, due to breed effect was significant (P<0.001) except for ash percent. The differences between means of the meat chemical analysis for experimental rabbits, due to weaning age effect were significant (P‹0.05). Rabbits weaned at 35 days of age had a higher meat ash and protein%, than rabbits weaned at 28 days of age, but rabbits weaned at 28days of age had a higher meat moisture and fat %, than rabbits weaned at 35 days of age, as showed in Table 3. The finding is in agreement with **Alfonso-Carrillo *et al.* (2014)** who concluded that meat moisture, protein and fat percent of *Oryctolagus Cuniculus* rabbits slaughtered at 46 days of age was 69.5, 17.8 and 7.78%, for rabbits weaned at 32 days of age, while, it was 71.1, 17.8 and 5.30%, for rabbits weaned at 46 days of age, respectively and the differences between means of meat moisture, protein and fat percent, due to weaning age effect was significant (P<0.05) except for protein percent. On contrary, **Marongiu *et al.* (2006)** working on crossbred rabbits (New Zealand White x Californian), observed that meat chemical analysis (moisture, ash, protein and fat%) of rabbits slaughtered at 83 days of age; it was 72.32, 1.44, 23.22 and 3.02%, for rabbit weaned at 28 days of age, while, it was 71.79, 1.47, 24.11 and 2.63%, for rabbits weaned at 63 days of age, respectively and the differences between means of rabbits meat chemical analysis, due to weaning age effect was not significant except for fat% (P<0.05). **Bivolarski *et al.* (2011)** found that meat chemical analysis (water, protein, fat and ash %) of New Zealand White rabbits slaughtered at 90 days of age was 73.48, 22.15, 3.38 and 1.09%, for rabbits early weaned at 21 days of age, while, it was 70.79, 24.40, 3.61 and 1.21%, for rabbits normally weaned at 35 days of age, respectively and the differences between means of

rabbits meat chemical analysis, due to weaning age effect was not significant except for water % (P<0.05). The differences between means the meat chemical analysis for experimental rabbits, due to housing system effect was significant (P‹0.05) for meat fat and ash% but, it was not significant for meat moisture and protein%. Floor housed rabbits had a higher protein and ash%, while, cages housed rabbits had a higher meat moisture and fat% as showed in Table 3. The finding is in agreement with **Dalle Zotte *et al*. (2015)** who observed that meat moisture, protein, lipids and ash percent of Pannon Large and Hungarian Gaint rabbits slaughtered at 12 weeks of age was 73.7, 21.9, 2.48 and 1.92%, for rabbits housed in cages, while, it was 73.7, 21.9, 2.38 and 2.03%, for rabbits housed in floor pens, respectively and the differences between means of rabbit's meat chemical analysis, due to housing system was not significant except for ash percent (P<0.05). Also, **Matics *et al*. (2019)** reported that meat moisture, protein, lipids and ash percent of Pannon Ka growing rabbits slaughtered at 11 weeks of age were 74.42, 21.40, 2.46 and 1.67%, for rabbits housed in cages, while, it were 75.00, 21.20, 2.00 and 1.77%, for rabbits housed in floor pens, respectively and the differences between means of meat chemical analysis, due to housing systems was not significant except for moisture and lipids% (P<0.05). The differences among means of meat quality, due to the interaction among rabbits breed, weaning age and housing system, were not significant.

Table3. Effect of weaning age, housing system on meat physical and chemical analysis of Moshtohor and V-line rabbits.

Items	Breed		Weaning age		Housing system		±SEM
	M	V-line	28 days	35 days	Cages	Floor	
Meat physical analysis:							
Tenderness	5.17[a]	5.06[b]	4.98[b]	5.25[a]	5.08	5.15	0.15
WHC	8.05[a]	7.85[b]	7.74[b]	8.16[a]	7.83[b]	8.07[a]	0.14
pH value	5.65	5.68	5.70	5.63	5.68	5.65	0.05
Meat chemical analysis:							
Moisture, %	74.16	74.03	74.47[a]	73.72[b]	74.25	73.94	0.15
Protein, %	21.5	21.1	20.8[b]	21.8[a]	21.22	21.42	0.14
Fat, %	2.20[b]	2.40[a]	2.44[a]	2.17[b]	2.40[a]	2.21[b]	0.05
Ash, %	1.55[a]	1.45[b]	1.33[b]	1.68[a]	1.42[b]	1.59[a]	0.02

[a, b] Means within any classification, followed by different letters are significantly different (P<0.05).

Conclusion

It could be concluded from the results of this study that using Moshtohor rabbits, reared in cages and weaned at 35 days of age had the best carcass traits and meat quality as well as it would be recommend that rabbits breeders consider the obtained results to gain these advantages.

References

Alfonso-Carrillo, C.; P. Garcia-Rebollar; C. De Blas; MA Ibanez and A. I. Garcia-Ruiz (2014). Effect of late weaning and use of altervative cages on performance of does, suckling and fattening rabbits under extensive reproductive management. Livestock Science, Vol. 167:425-434.

AOAC (2004). Official Methods of Analysis. 15th Association of Official Analytical Chemists Washington, D.C.

Apter, RC and Householder DD (1996). Weaning and weaning management of foals: a review and some recommendations. Journal of Equine Veterinary Science; 16:428–435. https://doi.org/10.1016/S0737-0806(96)80208-5

Armero, Q. and Blasco, A. (1992). Economic weights for rabbit selection indices.Proceedings 5 th world rabbit Congress, 25-30july, corvallis – USA, 637-42.

Belabbas, R.; M.D.L García; H. Ainbaziz; N. Benali; A. Berbar; Z. Boumahdi and M.J. Argente (2019). Growth performances, carcass traits, meat quality, and blood metabolic parameters in rabbits of local Algerian population and synthetic line. Veterinary World, 12(1): 55-62.

Bivolarski, B.L.; Vachkova, E.G.; Vachkova, Ekaterina G. ; Ribarski, S.S. and Ribarski, S.S. (2011). Effect of weaning age upon the slaughter and physicochemical traits of rabbit meat. Vet. arhiv 81, 499-511.

Cheeke, P. R. (1987). Rabbit production. Oregon State University, USA, Steven Lukefahr, Texas A&M University-Kingsville, USA, PP. 122.

Chodova, D.; Tůmova, E.; Martinec, M.; Bizkova, Z.; Skřivanova, V.; Volek, Z. and Zita L. (2014). Effect of housing system and genotype on rabbit meat quality. Czech J. Anim. Sci., 59 (4): 190–199.

Dal Bosco, A.; C. Castellini and C. Mugnai (2002). Rearing rabbits on a wire net floor or straw litter : behaviour, growth and meat qualitative traits. Livestock production Science, 75:149-156.

Dalle Zotte, A.; Szendro, K.; Gerencser, ZS; Szendro, ZS; Cullere, M.; Odermatt, M.; Radnai, I and Matics, ZS (2015). Effect of genotype, housing system and hay supplementation on carcass traits and meat quality of growing rabbits. Meat Science, Vol. 110:126-134.

Duncan, D. B. (1955). Multiple ranges and multiple F-test. Biometrics 11:1-42.

El- Sayad, G.A.E. and Abd EL-Rahman, G.A. (1990). Effect of inclusion of different levels of rumen content in diets for rabbits on carcass traits. Annals. Agric. Sci. Moshtohor, 25 (1):221-234.

El-Sheikh, T.M.; Mona M. Ghaly and T.S.T. Selem (2011). Comparative studies on some productive capabilites among imported, endogenous and native rabbit breeds under Egyptian environmental conditions. Lucrări Ştiinţifice - vol. 56, Seria Zootehnie Universitatea de Ştiinţe Agricole şi Medicină Veterinară Iaşi.

Eman, H A H (2019). Study on Some Reproductive Traits in Rabbits. Msc. Thesis, Fac. Agrc., Benha Univ., Egypt.

Fathi. M.; M. Abdelsalam; I. Al-Homidan; T. Ebeid; M. EL-Zarei and O. Abou-Emera (2017). Effect of probiotic supplementation and genotype on growth performance, carcass traits, hematological parameters and immunity of growing rabbits under hot environmental conditions. Animal Science Journal, Vol. 88, 1644–1650.

Iraqi, M.M.; Shenana, M.E. and Baselga, M. (2007). Some factors affecting production and milk composition characters in a crossbreeding experiment involving Gabali and V- line rabbits in Egypt.World Rabbit Science, 15: 151-159.

Iraqi, M. M.; Baselga, M.; Khalil, M.H.; Afifi, E.A.and Garcia, M. L. (2010). line Moshtohor (Egypt). The 6th Inter. Con. on Rabbit Prod. in Hot Clim., Assuit, Egypt, 97 – 104.

Khalil, M.; M. García; S. Al-Dobaib; A. Al-Homidan and M. Baselga (2005). Genetic evaluation of crossbreeding project involving Saudi and Spanish V line rabbits to synthesize new maternal lines in Saudi Arabia: I. Pre-weaning litter, lactation traits and feeding parameters. Proc. 4th International Conference on Rabbit Production in Hot Climates. 24-27 February 2005. Sharm El-Shiekh. Egypt.

Larzul, C.; Gondret, F.; Combes, S. and de Rochambeau H. (2005). Divergent selection on 63-day body weight in the rabbit: response on growth, carcass and muscle traits. Genet. Sel. Evol. 37 : 105-122.

Loponte, R.; G. Secci; S. Mancini; F. Bovera; V. Panettieri; A. Nizza; C. Di Meo; G. Piccolo and G. Parisi (2018). Effect of the housing system (free-range VS. open air cages) on growth performance, carcass and meat quality and antioxidant capacity of rabbits. Meat science, Vol. 145:137-143.

Marongiu, M.L.; Pinna, W.; Floris, B. and Nizza, A. (2006). Rabbit meat production as affected by a delayed weaning technique. In: Olaizola A. (ed.), Boutonnet J.P. (ed.), Bernués A. (ed.). Mediterranean livestock production: uncertainties and opportunities. Zaragoza: CIHEAM / CITA / CITA, 2006. p. 279-285 (Options Méditerranéennes: Série A. Séminaires Méditerranéens; n. 78).

Matics, Z.; M. Cullere; A.D. Zotte; K. Szendro; Z. Szendro; M. Odermatt; T. Atkari; I. Radnai; I. Nagy and Z. Gerencsér (2019). Effect of cage and pen housing on the live performance, carcasse, and meat quality traits of growing rabbits. Italian Journal of Animal Science. 18:1, 441-449.

NRC (2004). National Research Council.(9th Ed.) National Academy Press, Washington, DC.

Pinheiro, V.; Divanildo, O.M.; Severiano. S.; Jose, S. and Jose, L. M. (2011). Growth performance, carcass characteristics and meat quality of growing rabbits housed in cages or open-air park. Archiv Tierzucht 54 (2011) 6, 625-635.

Rashwan, A. A. and Marai I. F. M. (2000). Mortality in young rabbits. A Review. World Rabbit Science, 8(3): 111-124.

SAS (2004). SAS Procedure Guide ”version 9 Ed”. SAS Institute Inc., Cary, NS, USA.

Stewart, K. L. and Suckow, M. A. (2016). Effects of nominal differences in cage height and floor space on the wellbeing of rabbits. Journal of the American Association for Laboratory Animal Science. Vol 55, No 2 Pages 168–171.

Xiccato, G; Trocino, A; Filiou, E; Majolini, D and Zuffellato, M (2013). Bicellular cages VS. collective pen housing for rabbits: Growth performance, carcass and meat quality. Livestock Science, Vol. 155: 407-414.

Zita, L.; Z. Ledvinka; K. Mach; J. Kočár; L. Klesalová; A. Fučíková and H. Härtlová (2012). The effect of different weaning ages on performance in hyla rabbits, Proceedings 10 th World Rabbit Congress, Sharm El- Sheikh - Egypt, pp. 61-64.

تأثير عمر الفطام ونظام الأسكان على صفات وجودة الذبيحة فى أرانب الفى–لاين ومشتهر النامية

رجب عبد الحميد على أبو صالح ، أحمد سليمان محمود سليمان ، محمود رياض المهدى ، تامر مسعد محمد حسن
قسم الانتاج الحيوانى، كلية الزراعة بمشتهر، جامعة بنها، جمهورية مصر العربية

الهدف من الدراسة بحث تأثير سلالة أرانب (مشتهر والفى–لاين) وعمر الفطام (28 يوم و35 يوم) ونظام الأسكان (الأقفاص والأرضى) على صفات وجودة الذبيحة عن طريق أستخدام 120 ذكر أرانب تم تقسيمهم الى سلالتين (60 مشتهر و 60 فى–لاين) كل سلالة تم تقسيمها الى مجموعتين فطام (30 بعمر 28 يوم و 30 بعمر 35 يوم) كل مجموعة فطام تم تقسيمها الى مجموعتين لنظام الأسكان (15 أقفاص و 15 أرضى). تم تغذية أرانب التجربة على علف مركزتبعا لتوصيات الهيئة العامة للتغذية والأعلاف (2004) على حسب وزن الأرانب. تم تقديم العلف مرتين يوميا على وجبتين 8 صباحا و 4 مساءا لكل مجموعة يوميا. تم وزن أرانب كل مجموعة أسبوعيا من عمر 5 الى 13 أسبوع فى الصباح الباكر قبل التغذية والشرب. فى نهاية التجربة تم ذبح عدد ثلاث أرانب عشوائيا من كل مجموعة لتقييم صفات وجودة الذبيحة. أظهرت النتائج أن أرانب مشتهر المفطومة عند 35 يوم من العمر والمرباه فى أقفاص أفضل فى صفات وجودة الذبيحة عن باقى الأرانب ولذلك من خلال النتائج السابقة يمكن أستخلاص والتوصية بأستخدام أرانب مشتهر المرباه فى أقفاص والمفطومة على عمر 35 يوم للحصول على أفضل صفات وجودة الذبيحة.