INFLUENCE OF WEANING AGE AND HOUSING SYSTEM ON GROWTH PERFORMANCE, ECONOMIC EFFICIENCY AND BLOOD METABOLITES OF V-LINE AND MOSHTOHOR GROWING 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*

SUMMARY

Aims of this study was to investigate the influence of rabbits breed (Moshtohor vs. V-line), weaning age (28 and 35 days) and housing system (cages vs. floor type) ongrowth performance, economic efficiency andblood metabolites by using 120 male rabbits divided into two breeds (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 housed in cages and 15 rabbits raised on floor). All experimental rabbits were fed concentrate 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 am and 4:00 pm and estimated for each group every day. Both of the consumed diets and refusals were recorded daily. All rabbits in each group individually weekly weighed from 5 to 13 weeks of age in the morning before feeding and drinking. Average daily gain, feed intake, feed conversion ratio and the economic efficiency were calculated. Blood samples were taken from three rabbits of each group at the end of the experiment to evaluate blood metabolites. Results showed that Moshtohor rabbits weaned at 35 days of ageand were reared in cages had bettergrowth performance, economic efficiency andblood metabolites than the other ones. Thus, it could be concluded that rearing male Moshtohor rabbits, housed in cages and weaned at 35 days of age earn the bestgrowth performance, economic efficiency and blood metabolites.

Keywords: Weaning age, Housing system, Rabbits breed, Growth performance, Economic efficiency, Blood metabolites

INTRODUCTION

The rabbits breeding areone of the most successful investment projects, especially in recent years because rabbits are characterized by abundant production and rapid growth ratethanother 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 lineresulted from crossing Egyptian Sinai Gabali bucks with Spanish V-line does, where selection waspracticed on the crossbreds for litter weight atweaning and live weight at 56 days (Iraqi *et al*.,2007). These studies were based on evidence statingthat Spanish V-line rabbits and their crosses couldproduce and reproduce efficiently under hot climaticconditions (Khalil *et al*., 2005; Iraqi *et al*., 2010). Current study was conducted to investigate the weaning age (traditional and late weaning) and housing systems (floor and hatches type) of two male rabbit breeds (V-Line and Moshtohor rabbits) on growth performance, economic efficiency and blood metabolites.

MATERIALS AND METHODS

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

Management of experimental animals:

One hundred and twenty 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 feed 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.

Experimental diet:

All experimental rabbits were fed concentrate 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. Chemical analysis of the ration used in rabbit's diet

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 nutrition 2 %. It was analyzed according to AOAC (2004).
CP: crude protein, CF; crude fiber, EE: ether extract, NFE: nitrogen free extract.

Rabbits live performance:

All rabbits in each group individually weighed weekly to the nearest one gram after weaning (28 and 35 days of age) from 5 to 13weeks of age in the morning before feeding and drinking till the end of feeding period. Diets were offered twice daily in equal quantities at the 8:00 am and 4:00 pm and estimated for each of all groups every day. Both of consuming diets and refusals if any were recorded daily.

Average daily gain and feed conversion ratio were calculated according to Hassan *et al*. (2015).

Average daily gain = total gain (gram) / number of days of feeding period

Feed conversion ratio = feed intake (grams) / gain in weight (grams).

Economic efficiency (profitability):

Finance analysis was made to evaluate the profitability of experimental rabbits breed, weaning age and housing system effect. The net profit was calculated according to Sankhyan (1983) by the difference between total income and total costs. Total income and total costs were individually calculated for each rabbit. The total costs include: the feeding costs, rabbits purchased, the labor costs (price of a farmer working hour multiplied by the number of hours employed per rabbit, veterinary care costs (drugs, vaccines, and veterinary supervision). Water, electricity, equipment maintenance in addition to housing cost and farm rent value was also calculated per rabbit for each group. The total income included: income value from final live body weight (rabbit) and litter sale. All these parameters were estimated in L.E. over the course of the experiment.

Blood sampling and analysis:

The individual blood samples were collected at slaughter time from three rabbits within each group. Blood samples were collected after the addition of EDTA into dry clean tubes. The blood plasma was obtained by centrifuging the blood samples soon after collection at 3000 RPM for 15 minutes. The blood plasma was transferred into vials and stored in a deep freezer at -20◦C for subsequent specific chemical analysis: total protein according to Henry (1964), albumin according to Doumas *et al*. (1971), total lipids according to Frings *et al*. (1972). Concentration of total globulin in each sample was obtained by subtracting albumin concentrates from the total protein concentration and albumin globulin (A/G) ration was calculated by dividing albumin by total globulin. Single radial immune diffusion technique was used to quantify total immunoglobulin igG in blood plasma (bind ARIDtm Blinding site limited, Birmingham, UK) according to the method described by Fahey and Mckelvey (1965).

Statistical analysis:

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

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

Where:Y_{ijkl} =the observation of live performance, and economic efficiency 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 group and weaning age; $(BH)_{ik}$= the fixed effect of the interaction between breed group, and housing system; $(WH)_{ik}$= 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 $(0, \delta_e^2)$.The tests of significance for differences between means were carried out according to Duncan (1955).

RESULTS AND DISCUSSION

Rabbits growth performance:

Results in Table 2 showed that Moshtohor rabbits (2208 grams) had a heavier final live body weight than V-Line rabbits (2193 grams) at 13 weeks of age. The differences between means of rabbit's final body weight, due to breed effect were not significant. Similar results were found by Rahman *et al*. (2011) whoindicated that rabbits body weight at 2 years of age of New-Zealand White, New-Zealand Red and New-Zealand Black breeds was 1920, 1837 and 1978 grams, respectively and the differences among means

of rabbits body weight, due to breed effect were not significant. Fathi *et al*. (2017) showed that body weight of V-line and Gabali local rabbits at 16 weeks of age were 1817 and 2068.9 grams, respectively and the differences between means of rabbit's body weight, due to breed effect were not significant. In addition, Chandra *et al*. (2014) attributed the improvement in growth performance to good digestibility and absorption in the ilea. Rabbits weaned at 35 days of age showed higher final body weight than that weaned at 28 days of age (2238 vs. 2163 grams, respectively). The differences between means of rabbits final body weight at 13 weeks of age, due to weaning age effect were significant (P‹0.05) as shown in Table 2. Similar result of a higher live weight of the late weaned rabbits was recorded at 35 days of age by Xiccato *et al*. (2003), Zita *et al*. (2012) and Ali (2018).

Rabbits reared in cages had heavier final body weight (2203 grams) at 13 weeks of age than that reared on floor (2163 grams). The differences between means of rabbit's final body weight at 13 weeks of age, due to housing system effect were not significant. The same trend was observed by Alfonso-Carrillo *et al*. (2014) whoconcluded that body weight of *OryctolagusCuniculus* rabbits at 46 days of age was 4950 and 4728 grams, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbit's body weight, due to housing system effect was not significant, Heba *et al*. (2015) whofound that body weight of growing New Zealand rabbits at 10 weeks of age raised on different housing system were 1213.85 and 1322.85 grams, for rabbits housed at cages and floor, respectively and the differences between means of rabbit's body weight, due to housing system effect were not significant,. Stewart and Suckow (2016) concluded that body weight of New Zealand White rabbits was not affected by housing system (cages or floor pens) and the differences between means of rabbits body weight, due to housing system were not significant. The differences among means of rabbit's body weight at 13 weeks of age, may be due to the interaction among breed, weaning age and housing system, which were not significant.

It could be seen in Table 2 that average daily gain was not affected by rabbits breed, weaning age and housing system and their interactions.

Table 2. Effect of weaning age, housing system on live performance of Moshtohor and V-line growing rabbits

Items	Breed		Weaning age		Housing system		±SEM	Interaction		
	M	V-line	28 days	35 days	Cages	Floor		BW	BH	WH
Number of rabbits	60	60	60	60	60	60				
Initial body weight (g)	773	738	٧٢١	٧٨٩	٧٥٩	٧٥١	6.5	ns	ns	ns
Final body weight (g)	٢٢٠٨	٢١٩٣	٢١٦٣^{b}	٢٢٣٨^{a}	2203	٢١٩٧	12.9	ns	ns	ns
Average daily gain (g)	٢٥.٦	٢٥.٩	25.7	25.8	25.7	25.8	0.22	ns	ns	ns
Total DM feed intake (kg)	٦.٢٦^{b}	٦.٢٨^{a}	٦.٤٦^{a}	٦.٠٩^{b}	6.45^{a}	6.10^{b}	0.2	*	*	ns
Feed conversion ratio (feed/gain)	٤.٣٦	٤.٣٧	٤.٥١	٤.٢٢	4.51^{a}	4.23^{b}	0.3	*	*	ns

$^{a, b}$The means within any classification, followed by different letters are significantly different (P<0.05).
M= Moshtohor, ns= not significant,

These results are in contrast with Trocino *et al*. (2004) whoregarded that daily weight gain of Grimaud rabbits at 71 days of age was 48.6 and 48.4 grams/day, for rabbits housed at floor and cages, respectively and the differences between means of rabbit's daily weight gain, due to housing system effect were not significant, Kovacs *et al*., (2011) whoreported that daily weight gain of Pannon White rabbits during 36- 42 days of age was 33.6, 31.1 and 33.6 grams/day, for rabbits weaned at 21, 28 and 35 days of age, respectively and the differences among means of rabbits daily weight gain, due to weaning age effect were not significant, Matics *et al*. (2019) reported that daily weight gain of PannonKa growing rabbits during 5-11 weeks of age was 37.60 and 35.30 grams/day, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbit's daily weight gain, due to housing system effect were not significant.

V-Line rabbits weaned at 28 days of age and reared in cages consumed higher DM feed than Moshtohor rabbits weaned at 35 days of age and reared on floor. The differences between means of rabbits DM feed intake, due to breed, weaning age and housing system effects were significant (P<0.05) as shown in Table2. The results of our experiment are in accordance with the findings of Szendro *et al*. (2015) whofound that daily feed intake of Pannon Large and Hungarian Gaint rabbits during 5-12 weeks of age was 141 and 133 grams/day, for rabbits housed in cages and floor pens, respectively and the differences between means of rabbits daily feed intake, due to breed and weaning age effect were significant (P<0.05).Also, Loponte *et al*. (2018)

showed that daily feed intake of California × New Zealand White rabbits during 37-99 days of age was1.27 and 1.32 grams/day, for rabbits housed in cages and free range, respectively and the differences between means of rabbit's daily feed intake, due to housing system effect were significant (P<0.05).

Feed conversion ratio were not affected significantly by breed or weaning age of rabbits, while, rabbits reared in cages had a significant (P<0.05) higher value of feed conversion ratio than rabbits reared on floor (4.51 VS. 4.23, respectively), as showed in Table 2. Similar results observed by El -Sheikh *et al*. (2011) whonoticed that feed efficiency during 60 days of New-Zealand White, V-line, Baladi Black and Gabli rabbits was 0.32, 0.35, 0.37 and 0.32, respectively and the differences between means of rabbits feed efficiency, due to breed effect was significant (P<0.05), Belabbas *et al*. (2019) found thatfeed conversion ratioof local Algerian and synthetic line of rabbits at 91 days of age was 4.81 and 34.09, respectively and the differences between means of rabbit's feed conversion ratio, due to breed effect was significant (P<0.01).In addition,Dal Bosco *et al*. (2002) concluded that feed conversion ratio of Hybrid male rabbits during 0-70 days of age was 3.3 and 3.5, for rabbits housed in cages and straw bedded pens, respectively and the differences between means of rabbits feed conversion ratio, due to housing system effect was significant (P<0.01), Maha *et al*. (2015) showed that feed conversion ratio of growing New Zealand White rabbits during 5-13 weeks of age was 3.22, 3.14 and 3.07, for rabbits weaned at 25, 30 and 35 days of age, respectively and the differences among means of rabbit's feed conversion ratio, due to weaning age effect was significant (P<0.01).

Rabbit's economic efficiency:

Economic efficiency of experimental rabbits were significantly higher (P<0.05) for late weaned Moshtohor rabbits reared in cages than traditional weaned V-line rabbits reared on floor (Table 3). Moshotohor rabbits had the higher profitability than V-line rabbits (1.26 VS. 1.14), while, rabbits weaned at 35 days of age had the optimum economic value than rabbits weaned at 28 days of age (1.22 VS. 1.16). In final, rabbits reared in cages gained the higher economic efficiency than rabbits reared on floor (1.23 VS. 1.16). Similarly, Ayyat *et al*. (2002) found that Local rabbits breed had a higher significant economic efficiency (P<0.05) than other imported breed of rabbits under Egyptian condition, Salma *et al*. (2016) concluded that Moshtohor rabbits, the most local breed, had been improved as economic efficiency line. Also, Shalaby *et al*. (2016) using New Zealand White, California, Chinchilla and Rex rabbits and Gabr *et al*. (2017) usingCalifornia rabbits, they found that economic efficiency was affected by weaning age of growing rabbits (P<0.05). In addition, Mobolaji-Bukola *et al*. (2002) found that economic efficiency of Chinchilla, New Zealand White and Dutch rabbits during 0-6 months of age were 0.61 (89.22$) and 1.5 (58.18$), for rabbits housed in hutch and floor, respectively and the differences between means of rabbit's economic efficiency, due to housing system effect were significant (P<0.05).

Table 3. Effect of weaning age, housing system on economic efficiency (profitability) of Moshtohor and V-line growing rabbits

Items	Breed		Weaning age		Housing system	
	M	V-line	28 days	35 days	Cages	Floor
Body weight at 5 weeks of age, g	773	738	٧٢١	٧٨٩	٧٥٩	٧٥١
Body weight at 1٣ weeks of age, g	٢٢٠٨	٢١٩٣	٢١٦٣	٢٢٣٨	2203	٢١٩٧
Feed intake, kg	٦.٢٦	٦.٢٨	٦.٤٦	٦.٠٩	6.45	6.10
Feed intake cost, LE	37.56	37.68	38.76	36.54	38.70	36.60
Purchased rabbit, LE	60	70	65	65	65	65
Rabbit housing cost, LE	1.65	1.65	1.65	1.65	1.75	1.50
Total cost/rabbit, LE*	99.21	109.33	105.41	103.19	105.45	103.10
Rabbits sale, LE*	110.40	109.65	108.15	111.90	110.15	109.85
Litter sale, LE	15	15	15	15	20	10
Net profit, LE	125.40	124.65	123.15	126.90	130.15	119.85
Economic efficiency (Net profit / Total cost)	1.26[a]	1.14[b]	1.16[b]	1.22[a]	1.23[a]	1.16[b]

[a, b]The means within any classification, followed by different letters are significantly different (P<0.05). * Based on the price of the ingredients in the market during the experimental period. The prices were: feed consumed 6 LE/kg and weight gain 50 LE/kg.

Rabbits blood metabolites:

Differences between means of rabbit's blood proteins, due to breed effect were significant (P<0.05) except for total protein. Differences between means of rabbit's blood proteins, due to weaning age effect were significant (P<0.05) except for globulin. Differences between means of rabbit's blood proteins, due to housing system effect were significant (P<0.05) except for total protein and globulin. Moshtohor rabbits weaned at 35 days of age reared on floor had higher total protein, albumin and A/G ratio than V-line rabbits weaned at 28 days reared in cages. On contrary, globulin value was higher in V-line rabbits weaned at 35 days reared in cages (Table 4). Similar results reported by El-Sheikh *et al*. (2011) whoindicated that the differences among

means of blood proteins of New-Zealand White, V-line, Baladi Black and Gabli rabbits at 60 days of age and, due to breed effect were significant (P<0.05). Also, Maha *et al*. (2015) and Shalaby *et al*. (2016) whoshowed that the differences between means of blood proteins of growing New Zealand White, California, Chinchilla and Rex rabbits at 13 weeks of age, due to breed, weaning age and housing system effect were significant (P<0.05). The differences between means of rabbit's blood AST, ALT, cholesterol, triglyceride, HDL, LDL, uric acid and creatinine, due to breed, weaning and housing system effect were significant (P<0.05).V-line rabbits weaned at 28 days of age and reared in cages had higher blood AST, ALT, cholesterol, triglyceride, HDL, LDL, uric acid and creatinine than the other rabbits as shown in Table 4. The finding is in agreement with that of Al-Dobaib *et al*. (2007), Rahman *et al*. (2011) and Fathi *et al*. (2017). The differences between means of rabbit's blood IgG and IgM, due to breed, weaning and housing system effect were significant (P<0.05).Moshotohor rabbits weaned at 35 days of age and reared on floor had a higher value of IgG and IgM in blood than other rabbits. This result was in agreement with that ofEman (2019) and Elkomy *et al*. (2021) whofound thatthe immunity and health status of native rabbitsbreed was the most important issue for improving productive traits. Also, similar results were observed by El-Masry *et al.* (1994) whofound that immunoglobulin concentration of New Zealand White rabbits was affected (P<0.05) by weaning age and supplementation with selenium and vitamin E or zinc. In addition, Ayo-Ajasa *et al*. (2015) found that rabbits housing system influencing on immune response status.

Table 4. Effect of weaning age, housing system on blood metabolites of Moshtohor and V-line rabbits

Items	Breed		Weaning age		Housing system		±SEM	Interaction		
	M	V-line	28 days	35 days	Cages	Floor		BW	BH	WH
Total protein, g/dl	٥.٤٧	٥.٣١	٥.١٥^{b}	٥.٦٢^{a}	٥.٣٢	٥.٤٦	0.06	*	*	ns
Albumin, g/dl	٣.٨٤^{a}	٣.٥٠^{b}	٣.٤٦^{b}	٣.٨٧^{a}	٣.٥٥^{b}	٣.٧٨^{a}	0.05	*	*	ns
Globulin, g/dl	1.65^{b}	1.80^{a}	1.71	1.74	1.76	1.69	0.03	*	*	ns
A/G ratio	2.30^{a}	1.96^{b}	2.09^{b}	2.23^{a}	2.02^{b}	2.24^{a}	0.06	*	*	ns
AST, U/L	٣٢.٧^{b}	٣٤.٣٤^{a}	٣٥.٣٢^{b}	٣١.٧٣^{a}	٣٤.٥٤^{a}	٣٢.٥١^{b}	0.23	*	*	ns
ALT, U/L	١٩.٨٥^{b}	٢١.١٩^{a}	٢١.٦٥^{a}	١٩.٣٩^{b}	٢١.١٥^{a}	١٩.٨٨^{b}	0.18	*	*	ns
Triglycrides , mg/dl	٥٦.٦٥^{b}	٥٨.٠٨^{a}	٥٨.٩٣^{b}	٥٥.٨١^{a}	٥٨.٣١^{a}	٥٦.٤٣^{b}	0.21	*	*	ns
Cholesterol, mg/dl	٦٤.٦٧^{b}	٦٦.٢٨^{a}	٦٧.٣٤^{a}	٦٣.٦٢^{b}	٦٦.٣٠^{b}	٦٤.٦٦^{a}	0.20	*	*	ns
HDL, mg/dl	٣٧.١٧^{b}	٣٨.١٦^{a}	٣٩.٧٢^{a}	٣٥.٦١^{b}	٣٨.٥٠^{a}	٣٦.٨٢^{b}	0.24	*	*	ns
LDL, mg/dl	٢٧.٥١^{b}	٢٨.١٢^{a}	٢٧.٦٢^{b}	٢٨.٠٠^{a}	٢٧.٧٩	٢٧.٨٤	0.17	*	*	ns
Uric acid, mg/dl	٢٦.٤٢^{b}	٢٧.٤٥^{a}	٢٨.٢٢^{a}	٢٥.٦٥^{b}	٢٧.٦٠^{a}	٢٦.٢٧^{b}	0.18	*	*	ns
Creatinine, mg/dl	٠.٨٥^{b}	٠.٩١^{a}	٠.٩٢^{a}	٠.٨٣^{b}	٠.٩٠^{a}	٠.٨٦^{b}	0.007	*	*	ns
IgG, mg/dl	٤٥.٠٩^{a}	٤٢.٣٤^{b}	٤٢.٢٢^{b}	٤٥.٢١^{a}	٤٢.٩١^{b}	٤٤.٥٢^{a}	0.19	*	*	ns
IgM, mg/dl	٦٣.٣٥^{a}	٦١.٣٥^{b}	٦٠.٤٨^{b}	٦٤.٢٤^{a}	٦١.٦١^{b}	٦٣.١٠^{a}	0.25	*	*	ns

$^{a, b}$ means within any classification, followed by different letters are significantly different (P<0.05).
* = P<0.05, ns = not significant

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 bestgrowth performance, economic efficiency andblood metabolites as well asit would be recommend that rabbits breeders considerthe obtained results to gain these advantages.

REFERENCES

Al-Dobaib, S.N., M.H. Khalil, M. Hashad and A.M. Al-Saef, 2007. Growth, carcass and caecal traits in V-line and crossbred rabbits fed diet containing discarded dates. World Rabbit Science. 15: 81-90.

Alfonso-Carrillo, C., P. Garcia-Rebollar, C. De Blas, MA Ibanez andA. 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.

Ali, A.A., 2018. Comparison between the behavior, productive performance and stress level of different weaning ages of young rabbits., Department of Hygiene, Zoonoses and Animal Behavior, Faculty of Vet. Med., Suez Canal University, Ismailia, Egypt, SCVMJ, XXIII (1).

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

Apter, RC and D.D .Householder,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

Ayo-Ajasa, A., E. Sowande, A. Ozoje and Abel, 2015. Haematology and serum profile of rabbits due to generation interval, housing systems and sex. Nigerian Journal of Animal Production: Vol 10:60-70.

Ayyat, M.S., M.M. Soliman, U.M. Abed-ELmonem and S.M. EL-Sheikh, 2002. Performance of growth in rabbits as affected by some environmental conditions. Egyptian Journal of Animal Production, 12 :43-58.

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.

Chandra, S, M Mahender, M.G Prakash, T. Raghunandan and K.K Reddy, 2014. Productive performance of broiler rabbits fed diets supplemented with probiotic and enzymes under two systems of housing. Indian Journal of Animal Research 48,: 355–361.

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.

Doumas, B. T., W. A. Watson and H. G. Biggs, 1971. Colorimetric determination of albumin. Clin. Chem. Acta, 31: 87.

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

Elkomy, A., A. El-Hanoun, M. Abdella and K. El-Sabrout, 2021. Improving the reproductive, immunity and health status of rabbit does using honey bee venom. J Anim Physiol Anim Nutr. 2021; 105:975–983.

El-Masry,K. A. M., A. S. Nasr and T. H. Kamal, 1994. Influence of season and dietary supplementation with selenium and vitamin E or zinc on some blood constituents and semen quality of New Zealand White males. World Rabbit Science, 2 (3): 79- 86.

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.

Fahey and Mckelvey, 1965. Quantitative determination of serum immunoglobulins in antibody- agar plate. The journal of Immunology, Vol. 94 (1): 84-90.

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.

Frings, C. S., T. W. Fendly, R. T. Dunn and C. A. Queen, 1972. Improved determination of total serum lipids by the sulfophosphoalanine reaction. Clinical Chemistry, 18, 673-679.

Hassan, TMM, M.M. Abdella, G.A. El-Sayaad and R.Z.A. Kelyni, 2015. Effect of feeding different levels of water hyacinth on performance of growing rabbits. Egyptian Journal of Nutrition and Feeds. Vol. 18 (2): 225-228

Heba, S.A. G., N. A. Khattab, M. Y.I Youssef, A. K. Y. Saleem and H. H. Mohammed, 2015. Effect of cage floor type on behaviour, performance and carcass traits of growing rabbits. Zagazig Veterinary Journal, Volume 43, Number 3, p.10-19.

Henry, R. J., 1964. Clinical Chemistry, Harper and Row Publishers, New York P. 181.

Gabr, A.A., N. A. Shalaby and H. M. Rahma, 2017. Effect of weaning age and using mixture of cumin, mentha extracts with cow milk as a supplementation on growing rabbits performances. Asian Journal of Animal and Veterinary Advances, Vol. 12: 96-102.

Iraqi, M.M., M.E. Shenana and M. Baselga, 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., M. Baselga, M.H. Khalil,E.A. Afifi and M. L.Garcia,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.

Kovacs, M. , A. Bónai, Z. Szendrı, G. Milisits, H. Lukács, J. F.Szabo, G. Tornyos, Zs. Matics, F. Kovács and P. Horn, 2011. Effect of different weaning age (days 21, 28 and 35) on production, growth and certain parameters of the digestive tract in rabbits. Animal, 6:6, pp 894–901 & The Animal Consortium 2011.

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.

Maha, S.S.,W.A. Morsy, R.A. Mohamed, M.M. Eltholth and S.A. El-Midany, 2015. Effect of weaning age and housing model on feed intake, growth performance, hematobiochemical parameters and economic efficiency of post weaning New Zealand White rabbits. Alexandria Journal of Veterinary Sciences 2015, 46: 48-56

ISSN 1110-2047, www.alexjvs.com DOI: 10.5455/ajvs.189814.

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.

Mobolaji-Bukola, P U;E A Alison-Oguru;N A Berepubo and B M Oruwari, 2002. Bio-economic evaluation of the performance of rabbits raised under two different housing systems. Tropicutura, Vol. 20(4): 176-180.

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

Rahman, M., R. Khatum and M. Tania, 2011. Measurment of carcass and chemical parameters for meat yield and quality analysis of rabbits: A systematic search for source of complete protein. Global Veterenria 7 (1): 83-88.

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

Salma, E.H., H.S. Sherif, M.H. Khalil, Hoda A.S.E. and S. Ramadan, 2016. Comparative genetic analysis among Moshtohor line rabbits and their parental lines using microsatellite markers. 3 rd International Conference on Biotechnology Applications in Agriculture (ICBAA), Benha University, Moshtohor and Sharm El-Sheikh, 5-9 April 2016, Egypt.

Sankhyan, L.P., 1983. Introduction to Farm Management. Tata MC-Grow Hill Publishing Company Limited, New Delhi.

SAS, 2004. SAS Procedure Guide "version 9 Ed". SAS Institute Inc., Cary, NS, USA.

Shalaby, N.A. , A.A. Gabr and H.M. Rahma,2016. Effect of supplementing 21 day weaned rabbits with mixture of mentha, cumin extracts with cow milk on weaning performance of different rabbits' breeds. journal of Animal and Poultry Prod., Mansoura Univ., Vol.7(8): 319- 323.

Stewart, K. L. and M. A. Suckow,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.

Szendro, K., ZS Szendro, ZS Matics, A Dalle Zotte, M Odermatt, I Radnai and ZS Gerencser, 2015. Effect of genotype, housing system and hay supplementation on performance and ear lesions of growing rabbits. Livestock Science Vol. 174 : 105-112.

Trocino, A.,G. Xiccato,P.I. Queaque and A. Sartori, 2004. Group housing of growing rabbits: Effect of stocking density and cage floor on performance, welfare, and meat quality. 8th World Rabbit Congress- September 7-10, 2004- Puebla, Mexico

Xiccato, G, A., A. Trocino, A. Sartori and P. I. Queaque, 2003. Effect of weaning diet weaning age on growth, body composition and caecal fermentation of young rabbits. Animal Science, 77: 101-111.

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 أداء النمو والكفاءة الأقتصادية ومكونات الدم 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 (٢٨ يوم و٣٥ يوم) ونظام الأسكان (الأقفاص والأرضى) على أداء النمو والكفاءة الأقتصادية ومكونات الدم عن طريق أستخدام ١٢٠ ذكر أرانب تم تقسيمهم الى سلالتين (٦٠ مشتهر و ٦٠ فى-لاين) كل سلالة تم تقسيمها الى مجموعتين فطام (٣٠ بعمر ٢٨ يوم و ٣٠ بعمر ٣٥ يوم) كل مجموعة فطام تم تقسيمها الى مجموعتين لنظام الأسكان (١٥ أقفاص و ١٥ أرضى). تم تغذية أرانب التجربة على علف مركزتبعا لتوصيات الهيئة العامة للتغذية والأعلاف (٢٠٠٤)على حسب وزن الأرانب. تم تقديم العلف مرتين يوميا على وجبتين ٨ صباحا و ٤ مساءا لكل مجموعة يوميا. تم وزن أرانب كل مجموعة أسبوعيا من عمر ٥ الى ١٣ أسبوع فى الصباح الباكر قبل التغذية والشرب. تم تقدير متوسط الزيادة اليومية بوزن الجسم والمأكول الكلى ومعامل التحويل الغذائى والكفاءة الأقتصادية. تم أخذ عينات الدم من ثلاثة أرانب من كل مجموعة فى نهاية التجربة لتقييم مكونات الدم. أظهرت النتائج أن أرانب مشتهر المفطومة عند ٣٥ يوم من العمر والمرباه فى أقفاص أفضل أداء للنمو وكفاءة أقتصادية ومكونات الدم عن باقى الأرانب ولذلك من خلال النتائج السابقة يمكن أستخلاص والتوصية بأستخدام أرانب مشتهر المرباه فى أقفاص والمفطومة على عمر ٣٥ يوم للحصول على أفضل أداء للنمو وكفاءة أقتصادية ومكونات دم.