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EFFECT OF FEED RESTRICTION ON PRODUCTIVE PERFORMANCE, CARCASS YIELD, BLOOD PICTURES AND RELATIVE ORGAN WEIGHTS OF GROWING RABBITS

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ABSTRACT: Eighty weaning V-line rabbit's males aged 33days were used to study the effect of feeding restriction on productive performance of fattening rabbits. Rabbits were individually housed in galvanized wire cages and randomly allotted to four experimental groups (20 males per each), with initial average weight 635±12.25g. First rabbits group fed *ad libitum* commercial diet and served as control (C), second group (R1)fed restricted diet from the fifth to the sixth weeks of age (50 g /d /rabbit), third group (R2) fed restricted diet from eighth to ninth week of age (90 g/d/ rabbit) and the fourth group (R3) fed restricted diets from fifth to the sixth weeks of age (50 g /d/ rabbit) and from eighth to ninth weeks of age (90 g/d /rabbit) .Rabbits fed *ad libitum* at all other times of experiment. At the end of the experiment (84 days of age), five rabbits from each group were slaughtered to study carcass quality and some biochemical blood parameters.

Results indicated that body weight gain (BWG) for experimental restricted groups R1 and R2 (fed restricted diet for one week, short period) were statistically equal and insignificantly ($P \leq 0.05$) different compared with rabbit fed *ad libitum* (the control group, C). However, restricted group R3 (fed restricted diet during the fifth to the sixth / eighth to ninth weeks (long period) recorded the lowest significant BWG compared with the other experimental groups. Feed intake and daily feed intake for R3 group recorded the lowest significantly amount of feed intake by 16.9 % compared with the control group. Moreover, feed conversion (FCR) and mortality rates were significantly improved for rabbit groups exposed to feed restriction. Carcass and dressing percentages were significantly lowers ($P \leq 0.05$) for long period restriction (R3) compared with those for control (C) and for short periods restriction (R1 and R2).

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Key Words: Growing Rabbit, Feed Restriction, Blood, Growth and Carcass.

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Restriction had no significant effect on white blood cells but erythrocyte count, neutrophil % and hemoglobin concentration were significantly reduced by restriction systems compared with the control group. Restrictions of diet significantly ($P \leq 0.01$) reduced total lipid, cholesterol, total proteins and urea concentrations but triglyceride and phospholipids reduced ($P \leq 0.05$) as compared with the control group. The meat content of dry matter, crude protein, ether extract (DM, CP, EE) respectively and cholesterol were significantly ($P \leq 0.01$) decreased for restricted groups. Feed restriction significantly and gradual increased color intensity and tenderness while water holding capacity was decreased linearly.

In conclusion, using feed restriction for one week either at fifth or at eight weeks of growing rabbit ages could be recommended for realizing best results of growth performance and carcass.

INTRODUCTION

Rabbit production is gradually becoming an important source of income and employment generation in Egypt. Rabbit meat provides a cheap source of meat which is characterized by a high protein and low fat cholesterol content (Aduku and Olukosi, 1990),and it is considered a delicacy and a healthy food product (Dalle Zotte, 2000).Feed restriction is frequently applied to the rabbit females to avoid excessive fattening, reproduction troubles, and enhance reproductive results (Rommers, 2004) . In fattening rabbits, limited feed intake induces compensatory growth and improves feed efficiency (Gidenne *et al.* 2009), reduces fat in carcasses (Tumova *et al.* 2003, 2007), and sometimes decreases the incidence of post-weaning digestive disorders, such as rabbit epizootic enteropathy (Di Meo *et al.* 2007).The effect of feed restriction on meat quality depends on implementation can be impressed the intensity of feed restriction, its duration, and age when it is applied. The feed restriction is usually used for 1–5 weeks with intensity of intake limitation from 90 to 40% of the voluntary intake (Bovera *et al.* 2008). The limited feed intake decreases growth in the period of restriction .Gidenne *et al.* (2009) stated that a linear decreasing of growth is about 0.5 g/day per each percentage of feed reduction. Following the restriction, rabbits were fed *ad libitum* and it can exhibit in higher daily weight gain typical for compensatory growth (Tumova *et al.* 2002 and 2003). Therefore, growth curve in restricted rabbits may approach or copy the curve of the *ad libitum* fed animals (Andersen *et al.* 2005). Degree of compensation is indicated by previous growth and by intensity of the feed restriction. If the feed restrictions very intensive, then restricted fed animals despite the growth compensation cannot reach a weight of the *ad libitum* fed ones.Addass *et al.* (2012) referred that nutrition affects blood values of chickens. Dietary content affect the blood profile of healthy boiler chickens (Kurtuglu *et al.* 2005).Tumovet *et al.* (2007) reported that most parameters of blood picture were not influenced by feeding restricted.

The aim of this study was to determine the effect of employment controlled of feeding restriction on productive performance of fattening rabbits.

MATERIALS AND METHODS

The present study was carried out at El-Sabahia Poultry Research Station, Alexandria governorate, belonging to Animal Production Research Institute, Agricultural Research Center, Egypt.

Eighty four weaning V-line rabbits males aged 33days (V-line) with initial average weight 635±12.25g, were distributed randomly into four treatment groups (21males per each). At the end of

the experiment (84 days of age), five rabbits from each group to study carcass quality and blood parameters.

Experimental Design:

Group 1: rabbits were fed commercial diet and representing the control group (C).

Group 2: rabbits were fed restricted diet from the fifth to the sixth weeks of age (50 g/d /rabbit) (R1).

Group 3: rabbits were fed restricted diet from the eighth to ninth weeks of age (90 g/d/ rabbit) (R2).

Group 4: rabbits fed restricted diet from the fifth to the sixth weeks of age (50 g /d /rabbit) and from eight to ninth weeks of age (90 g/d/ rabbit) (R3).

Fed and water were offered *ad libitum* during unrestricted periods.

Housing and Management:

The rabbits were housed in a naturally ventilated building and kept in individual wire galvanized battery (60 × 55 × 40 cm). Batteries were accommodated with feeders for pelleted rations and automatic drinkers. Animals were kept under similar management and hygienic conditions. The lighting program provided 18 hrs of light per day. The averages for temperature and relative humidity (RH) during from October to November months (61 days) were 18º C (13 ºC as Min and 23 ºC as Max) and 71% RH (65% as Min and 75% as Max), respectively. The composition diet is illustrated in Table (1) according to AOAC (2007).

Data Collection:

Initial and final body weights (g), average weekly feed intake (g), and average weekly body weight gain, g (BW), Feed conversion ratio (FCR) and mortality rate were recorded. At the eight week of age, five rabbits were randomly selected from each of the four treatment groups. The rabbits were fasted for twenty four hrs (giving only water) and individually weighed using a scale. Rabbits were slaughtered by severing the carotid arteries and jugular veins, skinned and eviscerated for carcass analysis. After the removal of the visceral organs and head, the remaining part was measured as carcass weight and this was later expressed as percentage of the fasted weight to get the dressing percentage (Fielding, 1991).

Blood hematological constituents:

Hemoglobin concentration (Hgb, g/dl) was determined of fresh blood samples using hemoglobin meters as the method described by Tietz (1982). Red blood cells counts (RBC's) and MCV were detected according to the method of Helper (1966) , White blood cell counts (WBC's) was counted according to the method of Helper (1966), Hematocrite (%) according to the method of Helper (1966),Differential leukocytes counts were determined according to the method described by Lucky (1977).

Blood plasma biochemical constituents:

Plasma glucose was measured using the method of Hyvarinen and Nikkila (1962),total protein using the method of Doumas *et al.* (1981), urea and creatinine by the method of Henry (1974), Cabaud and Wroblewski (1958), respectively, plasma total lipids by the method of Chabrol and Charonnat (1973), plasma phospholipids by the method of Connerty *et al.* (1961), plasma triglycerides by the method of Fasati and Prencipe (1982), plasma total cholesterol by using the method of Stein (1986) .

Slaughter test:

At 84 day of age, five males per treatment were taken randomly, fasted for 18 hours before slaughtering with free water supply. Rabbits were weighed and slaughtered for complete depletion. After bleeding, rabbits were weighed and skinned. Then they were weighed after and the carcasses were eviscerated. The following carcass traits were obtained. Pre slaughter weight: Live body weight was recorded for each rabbit in grams before slaughter process. Dressing percentage: Dressing percentage was

detected for each rabbit by dividing the weight of hot eviscerated carcass including liver, kidney, spleen, testes, lungs and head by the weight of live body weight. Organs weights as a percentage of live body weight were calculated for Intestine, liver, kidney, and Spleen, Testes, and Pituitary gland. Fresh samples of meat was taken individually from each rabbit for physical characteristics determination Water holding capacity (WHC) and tenderness were measured according to the method of Volvoinskaiaa and Kelman (1962); pH value was measured by pH meter as described by Aitken *et al.* (1962);color intensity of meat were determined according to the method of Husani *et al*. (1950). Chemical compositions of meat on fresh basis were determined according to AOAC (1995), and a cholesterol value of meat was carried detected after extraction of lipids by the method of Folch (1957). Cholesterol was determined using commercial kits produced by Diamond Diagnostics Company (29 Tahreer st.Dokki, Giza, Egypt).

Economical efficiency:

The economical efficiency was calculated according to Mosaad (2007) as follows: Economical efficiency (%) = (Net revenue/ Total cost) x 100, Whereas, Net revenue = Total revenue -Total cost. Total cost = (Total feed intake x Kg feed cost) + (Total housing, medication and care cost (L.E.) /doe). The price of ingredients and selling of does rabbits in the local market at the time of experiment in (2014) year.

Statistical analysis:

Data were processed by one-way analysis of variance using Genstat (2005) statistical package. The significance of difference among treatment groups was tested using Least Significance Difference (LSD) method on the level ($p<0.05$).

RESULTS AND DISCUSSION

Growth Performance:

Body weight and body weight gain:

Results of body weight gain (BWG) during the whole experimental period and daily weight as show in Table 2 indicated the feed restriction for long period (R3), significantly had lowest records of the previous mentioned traits compared with those for the restriction experimental groups (C, R1 and R2).Whereas rabbit groups fed restricted diet (R1 and R2) did not represent an statistical differences compared with control one with respect to the same mentioned traits. The decrease in BWG with increasing the restriction period is in agreement with the result of Dalle Zotte *et al.* (2005) and Gidenne *et al*.(2009) applied restriction between the fifth to the sixth weeks and they detected decreasing of live weight with increasing intensity of feed restriction.Gidenne *et al*. (2009) registered the decrease of 4.5 g the live weight per each percentage of the restriction. Consequently, compensatory growth and thus the influencing of live weight depends on intensity and time of application the feed restriction. It seems that rabbits after longer and stronger restriction cannot compensate live weight, but moderate restriction had no effect on live weight.

The compensatory of growth for restricted rabbit groups R 1 and R 2are in agreement with findings of Tůmová *et al*.(2003 and 2007) they referred that one week of restriction produced compensatory growth. On the other hand, reduced BWG and daily weight gain for R 3 group than the other groups might be linked to lower daily feed intake.

Feed intake:

Feed restriction significantly decreased total feed intake and daily feed intake for all experimental groups compared with *ad libitum* fed control group (Table 2). However, rabbit of R3 group significantly consumed lowest amount of feed by 16.9 % compared with the control group. These results are in agreement with those reported by Chiericato *et al*. (2001) who mentioned that feed restriction negatively influenced

(P<0.01) feed intake in female rabbits during prepuberty. Whereas, Klindt *et al*. (2001) found that moderate feed restriction reduced feed consumed from 13 wk of age to end of the first pregnancy. Tumova *et al.* (2003) and Mosaad. (2007) documented that the daily feed intake in restricted fed rabbits was lower than in rabbits fed *ad libitum.*

Feed conversion ratio:

The best significant improvement of feed conversion rations had been detected for rabbit groups fed with restricted diet as shown in R1 and R2 groups compared with those for control and long restriction period group (R3).It is concluded from these results that feed restriction for short period (one week) is more effective for improving feed conversion ratio. This conclusion is in harmony with those previously mentioned by several authors who reported who reported that a restricted feeding improved the feed efficiency (Yakubu *et al.* 2007and Gidenne *et al.* 2012).On the other hand,Tumova *et al*. (2003) showed that feed efficiency did not significantly affected by feed restriction systems for growing rabbits .Also; Gidenne *et al.* (2009) revealed that feed restriction during 21 days after weaning reduced linearly the feed conversion ratio over the whole fattening period.

Mortality rate:

Feed restriction significantly ($P \leq 0.05$) improved mortality rate for experimental groups compared with the control group. Mortality rate was 2.18 % in the control group and significantly ($P \leq 0.01$) decreased to 1.07% and 1.02 for groups of feed restriction R1 and R 2; and reached 1.33%for group R3. However, mortality rates for restricted groups (R1 and R 2) who exposed to one week restriction were statistically equals and had the lowest significant ($P \leq 0.01$) rate compared with the other experimental groups Table (2). These results confirm several previous studies which indicated that feed restriction influence mortality of rabbits. On the other hand, Tumova *et al.* (2002) documented that a short feed restriction (50 g/d/rabbit from the fifth to the sixth weeks or 65 g/d/rabbit from 42 to 49 d of age) did not affect mortality, while a more long restriction (for 2 or 3 weeks) reduced mortality

Effect of feed restriction strategy on slaughter traits:

Carcass parts:

Analysis of variance for experimental groups fed different restriction strategies for proportional weight of carcass traits showed significant effects on carcass weight besides dressing ,loin and skin percentages, while the other studied traits did not significantly affected by feed restriction (Table 3).Carcass weight and dressing percentage were significantly lower ($P \leq 0.05$) for rabbits restricted for long period (R3) comparison with rabbits fed *ad libitum* (C) or fed restricted diets(R1 and R2) for short period(Table3).Similar results were detected by Gidenne *et al.* (2009) who revealed significant reduction of dressing percentage in restricted rabbits (between days 34–55of age) than in the *ad libitum* fed ones, but groups with various intensities of restriction (80, 70, or 60% of *ad libitum*) did not mutually differ. Generally, a negative effect of feed restriction on dressing percentage might be caused by a rate of compensatory growth and therefore final live weight.

Feed restriction had a significant ($P \leq 0.01$) effect on the proportion of loin, since the highest percentage ($P \leq 0.01$) was detected for the *ad libitum* group, while restricted groups had a lower proportion of loin compared with C group. However, R3 group ($P \leq 0.01$) had significantly lowest loin percentage. These results are in accordance with these reported by Ferreira and Carregal (1996) who stated decreasing of the loin proportion of the carcass in rabbits restricted on 50% of *ad libitum* between days70–120 of age. Tumova *et al.* (2006) detected the effect of beginning and length restriction on the loin proportion.

They registered a significantly ($P \leq 0.05$) lower proportion of loin in restricted rabbits than in the ad libitum fed rabbits. On the other hand, skin recorded high significant ($P \leq 0.01$) in R1 groups while ad libitum and R2groups recorded the same trends, but R3group had significantly ($P \leq 0.01$) lower percentage.

Generally, results of Table 3 indicated that the other carcass traits did not significantly differ among experimental groups. Contradictory findings in results of carcass composition could be caused by different intensity and time of feed restriction. However, these results are in agreement with those reported by Tumova et al. (2006) who did not find out differences in share of hind legs in ad libitum fed and restricted rabbits with various durations of limited feed intake. On the other hand, Matics et al. (2008) found significantly higher proportion of hind legs to the body weight in ad libitum fed rabbits than in the restricted group .Gidenne et al. (2009) stated that rabbits with restriction on 70%of ad libitum between days 34–55 had significantly reduced percentage of hind leg from carcass, but rabbits with restriction on 80 or 60% of ad libitum in the same period did not differ from the ad libitum fed group.

Digestive tract, intestinal and organs weight:

Analysis of variance for experimental groups fed different restriction strategies showed insignificant effects on relative weight of intestinal and some organs of growing rabbits (Table3).These results are in agreement with different researcher workers as Maria Cristina et al. (2013) reported that vital organs such as brain, lungs, kidneys, heart, and small intestine are proportionally more developed at the birth time and, as a consequence, grow up proportionally less in the postnatal life. This different organ growth during the prenatal period modulates the effects of restriction on the organ development after the birth. Organs with precocious growth are less affected by the postnatal restriction (Geraseev et al. 2008).

There was a great variation in the results found in the literature, probably due to the differences in the restriction level, duration and period. Normally, viscera show fast responses to the feed restriction by the reduction in their sizes and metabolic activities (Lawrence and Fowler, 2002). However, Tumová et al. (2003) did not report differences in the absolute weight of the kidneys and liver in rabbits subjected to feed restriction at different ages according to Tumová et al. (2007), feed restriction reduced the intestine weight. Farther more, Mazeti et al. (2008) verified a higher relative weight in restricted animals, compared with control.

Blood constituents:

Table (4) shows that feed restriction had no significant effect on WBC's as compared with the control but erythrocyte count, neutrophil percentage and hemoglobin concentration were significantly reduced by feed restriction system compared with the control group. This reduction in hemoglobin content was suggested to be due to the observed reduction in erythrocytes' counts. Whereas, lymphocyte percent and MCV were significantly increased compared with the control group. The values of the haematological characteristics were within the physiological range described by Tůmová et al. (2007). El-Moty and El-Moty (1991) concluded that haematocrit was significantly decreased by feed restriction in rabbits. Besides; Tumova et al. (2004) observed ($P \leq 0.05$) lower number of neutrophiles and higher number of lymphocytes due to feed restriction.

Blood biochemical parameter:

Results indicated that all studied parameters were significantly affected by feed restriction except plasma creatinine and glucose concentrations (Table5). Feed restriction systems significantly

($P \leq 0.01$) reduced total lipids, cholesterol, total proteins and urea concentration, but phospholipids and triglyceride were statistically ($P \leq 0.05$) reduce compared with the control group (Table5). Results of glucose concentration in this experiment are in accordance with Van Harten and Cardoso (2010) who observed that feed restriction did not reduce plasma glucose and this might be attributed to no need for an increase in catabolizing glucose since the level and the activity of glucose 6-phosphate did not change with feed restriction. Results reported herein regarding reduction of triglyceride and free fatty acids are in accordance with the report of Van Harten and Cardoso (2010) who stated that feed restriction significantly reduced triglyceride and free fatty acids in rabbits and induced a higher lipidic depletion in these animals.

Chemical composition of meat:

Table (6) reveals the effect of feed restriction on chemical composition for meat of V-line growing rabbits at 84 days of age. The results indicated that restricted the feed significantly ($P \leq 0.01$) decreased the meat content of dry matter, crude protein, cholesterol besides ether extract significantly ($P \leq 0.05$). Moreover, the results showed that differences in ash (%) did not statistically differ between experimental. Meat chemical composition is an important indicator form eat quality and feed restriction is one from several factors which affect the comical composition .The decrease in dry matter contents associated with increase of moisture content. Results reported herein are compatible with the observation of Likewise Larzul *et al.* (2004) who detected significant higher water content in rabbits with quantitative restriction than in the *ad libitum* fed ones. Also, Metzger *et al.* (2009) detected significantly higher moisture content in rabbits with energy restriction. Chemical analysis of rabbit meat indicated that water content is negatively correlated with lipid content in meat and this result is keeping with result of Bernardin *et al.* (1994).Perrier (1998) reported lower fat content compared to those fed *ad libitum*. Similar results are described by Tumova *et al.* (2003and 2007) and Larzul *et al.* (2004). Xicatto (1999) demonstrated lower fat content (9.4%) in restricted rabbits (80% of *ad libitum*) than in the *ad libitum* fed group (13.8%) and he indicated that more intensive restriction decreased fat in higher range. Larzul *et al.* (2004) determined lower percentage of lipid content in rabbit's meat with limited feed intake. On the other hand, significantly higher fat content was detected by Tumova *et al.* (2003) in rabbits restricted one week than in the *ad libitum* fed group. However, it has been shown that an improvement in growth rate during the *ad libitum* feeding period increases the development of late-stagetissue and especially adipose tissue (Ouhayoun, 2003).Part of the fat is stored directly into the muscles and causes marbling of meat, which is the source of taste and juiciness of the meat. The precise mechanism by which accumulation of intramuscular lipids is impaired by feed restriction is not understood. Marbling may be due to de novo lipogenesis in the intramuscular adipose tissue and occurs as a result of an uptake of fatty acids via lipoprotein lipase activity (Gondert *et al.* 2000).

Lipids and fatty acid composition defines the nutritive value and the organo-leptic value of meat (Ouhayoun and Dallzotte, 1996). The lower lipid content in restricted rabbits might be probably due to a decrease in activities of the enzymes implicated in fatty acid biosynthesis (malic enzyme and glucose- 6-phosphate dehydrogenase) as reported by Gondret *et al*.(1997). Rabbit meat proteins have a high nutritional value, because it contains all essential amino acids. Results reported herein indicated that feed restriction decreased the content of crude protein in rabbit exposed to feed restriction and these results are in agreement with those reported

by Lebas and Ouhayoun (1987) demonstrated a significant decrease in the intensively growing muscles in rabbits with low protein ratio in feed. On the other hand, in quantitatively restricted rabbits, Xiccato (1999) showed slightly higher protein level in rabbits with restriction than in those fed ad libitum.

Physical characteristics of meat:

The effects of feed restriction on physical characteristics of V-line growing rabbit meat at 84 day of age are shown in Table (6). Results indicated that feed restriction significantly and gradual increased color intensity and tenderness but decreased WHC linearly. A difference in pH was not significantly affected by feed restriction. Meat colour is an important meat quality trait that is partly related to muscle energy metabolism, ultimate pH, and processing or storage conditions of meat as mentioned by Ouhayoun and, Dallezotte (1996). Colour of meat is dependent on pigment content (myoglobin and haemoglobin), which is reliant on breed and age (Pla, 2008), as well as on ante and post mortem con dictions. Nutrition is one of the parameters which can affect meat colour parameters. These parameters also depend on the type of muscles where the colour is measured in rabbits. Only few authors investigated the effect of intensity of limited feed intake on rabbit meat colour parameters. They did not determine differences in lightness, yellowness, and redness parameters between rabbits with various intensity of feed restriction and the ad libitum fed group (Gidenne et al. 2009). Carrilho et al. (2009) found significantly lower lightness of musculus Longissimus dorsi in rabbits with low fiber content in diet than in medium or high fiber content in diet fed for three weeks after weaning.

Hernandez et al. (2000) investigated the correlation between parameters of meat qualityand they observed high positive correlation between pH of musculus Longissimus dorsi and that of Biceps femoris. It has been shown that feed restriction promotes oxidative metabolism of muscle fibers (Metzger et al. 2009). Dallezotte and Ouhayoun (1995) reported that the feed restricted rabbits had significantly higher muscle pH value compared to the ad libitum fed rabbits. Perrier and Ouhayoun (1996) found differences between various rationing plans on average pH ultimate value and they observed significantly lowest ultimate pH of the thigh muscles (5.73) in rabbits with restriction on70–90%, groups restricted on 80% and on 90–70% of ad libitum did not mutually differ and the authors assumed that improvement of the muscular glycolytic metabolic pathway as the reason.

Economical Efficiency:

Calculations were carried out according to the prices of feed diet, cost of management and meat rabbit during years 2013/2014 as listed in Table (7).The economic efficiency values of V-line rabbit feed restricted on growth performance during the entire period from 33-84 days of age were 0.99, 1.21, 1.18 and 1.06 and relative economic efficiency 99, 121., 118 and 106%for control, R1, R2and R3 groups respectively. Feed restriction strategy of fattening weaning rabbits resulted in clear improvement of net revenue and relative economic efficiency as compared to the control group. In conclusion, using feed restriction for one week either at fifth or at eight weeks of growing rabbit ages could be recommended for realizing best results of growth performance and carcass.

Table) 1).Composition of concentrate diet fed to rabbit

Ingredients	Pellet concentrate	Determined and calculated composition	
Berseem hay	40.0	Dry matter (DM)[2], %	89.67
Yellow corn	10.0	Crude protein (CP)[2], %	17.18
Barley	13.0	Crude fiber (CF)[2], %	13.05
Wheat bran	15.0	Ether extract (EE)[2], %	3.41
Soybean meal	17.5	Nitrogen free extract (NFE)[3], %	56.03
Soybean lecithin	0.0	Ash[2], %	10.33
Molasses	3.0	(DE)[3]Kcal/Kg	2519
Di-calcium phosphate	0.8	Calcium [3], %	0.83
Sodium chloride	0.3	Available phosphorus[3], %	0.31
Vit+Min Premix[1]	0.3	Methionine[3], %	0.36
DL-Methionine	0.1	Total sulphur amino acid [3], %	0.68
Total	100	Lysine[3], %	0.98

Proximate analysis of pellet concentrates feed (% on a dry matter basis) [1]Vit+Min mixture provides per kilogram contains: Vit A 6000 IU; Vit $D_3$450 IU; Vit E 40 mg; Vit K_3 1 mg; Vit B_1 1 mg; Vit B_2 3 mg; Vit B_3 180 mg; Vit B_6 39 mg; Vit B_{12} 2.5 mg; Pantothenic acid 10 mg; biotin 10 mg; folic acid 2.5 mg; choline chloride 1200 mg; Manganese 15 mg; Zinc 35 mg; Iron 38 mg; Copper 5 mg; Selenium 0.1 mg; Iodine 0.2 mg; Selenium 0.05 mg. [2]Analyzed values according to AOAC (2007). [3]Calculated values according to NRC (1977). DE calculated according to Cheeke (1987). *NDF%, NDF%=28.92+0.657*CF%. Digestible energy = (DE) [3] 25193 Kcal/Kg

Table (2): Effect of feed restriction on growth performance for growing V-line rabbits

Parameter	Feed restriction (days of age)				Sig
	C	R1	R2	R3	
Initial Body weight (g)	637	638	633	642	NS
Body weight gain (g)	1168[a]	1158[a]	1154[a]	1015[b]	*
Daily weight gain (g)	23.36[a]	23.16[a]	23.06[a]	20.50[b]	*
Feed intake(g /period	4337.52[a]	3827.29[b]	3923.44[b]	3604.40[c]	**
Daily feed intake (g)	86.75[a]	78.18[b]	78.46[b]	72.08[c]	*
Feed conversion ratio	3.71[a]	3.30[c]	3.39[c]	3.55[b]	*
Mortality rate	2.18[a]	1.07[c]	1.02[c]	1.33[b]	**

[abc] Means in the same row without common superscripts are significantly different. C: free feeding (*ad libitum*). R1: restricted from fifth to the sixth weeks of age (R2): restricted from the eighth to ninth weeks of age R3: from the fifth to the sixth weeks of age and from eight to ninth weeks of age

Table (3): Effect of feed restriction on carcass traits of growing V-line rabbits

Parameter	Feed restriction (days of age)				Sig
	C	R1	R2	R3	
Carcass weight (g)	1063[a]	1067 [a]	1059[a]	965[b]	*
Dressing (%)	59.00 [a]	59.54 [a]	59.19 [a]	56.46 [b]	*
Hind part of the carcass (%)	49.21	48.62	47.80	47.53	NS
Fore part of the carcass (%)	42.05	42.06	41.08	42.53	NS
Loin (%)	14.80[a]	13.48[b]	13.88[b]	12.94[c]	**
Hind legs (%)	28.92	29.27	28.82	29.29	NS
Thigh muscles %	21.43	21.50	21.64	20.46	NS
Intestine weight (%)	5.57	5.56	5.43	5.45	NS
Stomach weight (%)	1.70	1.75	1.77	1.85	NS
Liver weight (%)	5.22	5.44	5.53	5.51	NS
Kidney weight (%)	1.05	1.13	1.09	1.14	NS
Spleen weight (%)	0.08	0.09	0.08	0.08	NS
Testes weight (%)	0.14	0.14	0.14	0.15	NS
Pituitary weight (%)	0.002	0.002	0.002	0.002	NS
Skin%	16.45[b]	17.64[a]	16.35[b]	14.61[c]	**

[abc] Means in the same row without common superscripts are significantly different.
C: free feeding (*ad libitum*). R1: restricted from fifth to the sixth weeks of age (R2): restricted from the eighth to ninth weeks of age R3: from the fifth to the sixth weeks of age and from eight to ninth weeks of age

Table (4): Effect of feed restriction on haematological parameters at 84 days of age in growing V-line rabbits

Parameter	Feed restriction (days of age)				Sig
	C	R1	R2	R3	
Erythrocyte counts (R.B.C's)(10^6/mm^3)	6.19 [a]	5.69 [b]	5.41 [b]	5.46 [b]	**
Leukocyte number (WBC's) (10^3/mm^3)	5.54	5.14	5.35	5.49	NS
Lymphocyte number (%)	65.48[b]	78.18[a]	79.65[a]	78.65[a]	**
Neutrophil number (%)	29.91[a]	21.41[b]	20.04[c]	20.04[c]	*
Haematocrit (%)	45.08[a]	42.44[b]	41.04[b]	40.77[c]	**
Mean cell volume (MCV)	72.83[c]	74.59[b]	75.87[a]	74.67[b]	**
Hemoglobin (Hb) (g/d1)	12.65[a]	11.25[b]	11.30[b]	11.50[b]	**

[abc] Means in the same row without common superscripts are significantly different.
C: free feeding (*ad libitum*). R1: restricted from fifth to the sixth weeks of age (R2): restricted from the eighth to ninth weeks of age R3: from the fifth to the sixth weeks of age and from eight to ninth weeks of age

Table (5): Effect of feed restriction on some blood biochemical parameters at 84 days of age in growing V-line rabbits.

Parameter	Feed restriction (days of age)				Sig
	C	R1	R2	R3	
Total lipid (mg/dl)	466.88[a]	421.61[b]	428.43[b]	418.25[b]	**
Phospholipids (mg/dl)	184.82[a]	169.97[b]	163.81[b]	148.32[c]	*
Triglyceride (mg/dl)	39.62[a]	34.96[b]	33.94[b]	32.39[b]	*
Cholesterol (mg/dl)	128.07[a]	121.22[b]	120.34[b]	119.11[b]	**
Total proteins (g/dl)	54.68[a]	50.21[b]	50.10[b]	49.89[b]	**
Creatininea (mg/dl)	1.33	1.30	1.29	1.28	NS
Glucose (mg/dl)	111.13	110.75	109.33	107.23	NS
Urea (mg/dl)	45.93[a]	42.45[b]	41.29[b]	40.18[b]	**

[abc] Means in the same row without common superscripts are significantly different. Linear body measurements of weaner rabbits.

C: free feeding (*ad libitum*). R1: restricted from fifth to the sixth weeks of age (R2): restricted from the eighth to ninth weeks of age R3: from the fifth to the sixth weeks of age and from eight to ninth weeks of age

Table (6): Effect of feed restriction on chemical composition and physical characteristics of meat for V-Line growing rabbits at 84 days of age

Parameter	Feed restriction (days of age)				
	C	R1	R2	R3	Sig
Chemical composition of meat %					
DM	37.23 [a]	34.61 [b]	32.93 [c]	25.33 [d]	**
CP	19.42[ab]	18.35 [b]	18.29 [b]	17.21 [c]	**
EE	5.54[a]	4.86[b]	4.79[b]	4.24[c]	*
Ash	1.11	1.10	1.10	1.12	NS
Cholesterol	71.53[a]	68.69[ab]	66.11[b]	63.77[c]	**
Physical characteristics of meat					
pH	5.97	5.89	5.92	5.99	NS
Color intensity	0.193[c]	0.213[b]	0.232[a]	0.240[a]	**
Tenderness (cm^2/g)	2.76[c]	2.92[b]	3.07[a]	3.08[a]	*
WHC (cm^2/g)	5.80[a]	5.71[b]	5.59[c]	5.50[d]	**

[abc] Means in the same row without common superscripts are significantly different.

C: free feeding (*ad libitum*). R1: restricted from fifth to the sixth weeks of age (R2): restricted from the eighth to ninth weeks of age R3: from the fifth to the sixth weeks of age and from eight to ninth weeks of age WHC= water holding capacity. DM= dry matter. CP= crude protein. EE = ether extract

Table (7): Economical Efficiency of fattening V-line rabbits as affected by feed restriction

Items	Feeding restriction			
	C	R1	R2	R 3
Body weight at marketing (kg)	1805	1796	1787	1657
Body weight gain (g)	1168	1158	1154	1015
Price body weight gain (L.E.)	29.20	28.95	28.85	25.38
Total feed intake litter at marketing (kg)	4.33	3.80	3.91	3.60
Total feed cost (L.E.)	13.86	12.16	12.48	11.52
Total cost of managements (L.E.) /litter	0.75	0 .75	0.75	0.75
Total cost (L.E.)	14.61	12.91	13.23	12.27
Net revenue (L.E.)	14.59	15.66	15.62	13.11
Economical efficiency	0.99	1.21	1.18	1.06
Relative economic efficiency (%)	99	121	118	106

Total cost of feed = (Total feed intake × Kg feed cost)
Total cost of managements (L.E.) / litter =cost of housing +cost of medication +cost of care
Total cost = (Total feed intake × Kg feed cost) + Total of managements
The Net revenue = Total revenue -Total cost price
Economical efficiency =Net revenue / Total cost
Relative Economical efficiency (%) = (Net revenue/ Total cost) x 100f ingredients and selling of does rabbits in the local market at the time of experiment (2014).
Price of one kg pellets diet was 3.20 L.E. and one month of breed 15 L.E and meat was 25 L.E.

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الملخص العربى

تأثير التحديدالغذائى على الاداءالانتاجى وصفات الذبيحةوصورة الدم ووزن الاعضاء النسبيى للأرانب النامية

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تم استخدام ثمانون ذكور من سلالةالفالين المفطومة عند عمر ٣٣ يوم لدراسة تأثير استخدام نظام التحكم فى التغذية على الأداء الإنتاجي لأرنب التسمين. وتم إيواء الأرانب بشكل فردي في أقفاص من السلك المجلفن وتم توزيعها عشوائيا إلى أربع مجموعات تجريبية (٢٠ ذكرا لكل منهما)، متوسط الوزن ٦٣٥ ± ١٢,٢٥جرام وتمت تغذية ارانبالمجموعة الأولىتغذية حرة وأستخدمت كمجموعة مقارنة، المجموعة الثانيةغذيت على ٥٠ جرام/ ارنب/ يوم خلال فترة من الاسبوع الخامس وحتى السادس من العمر ، المجموعة الثالثةغذيت على ٩٠ جم / أرنب/ يوم خلال الفترة من الثامن وحتى التاسع من العمر والمجموعة الرابعة غذيت على تقييد الغذاء بمعدل ٥٠ جم / أرنب /يوم خلال الفترة من الخامس وحتى السادس يوما من العمر و٩٠ جم / أرنب /يوم خلال الفترة من الثامن وحتى التاسع من العمر. وتمت تغذية الارانب في جميع الأوقات الأخرى من التجربة تغذية حرة. في نهاية التجربة عند عمر٨٤ يوما ، تم ذبح عدد ٥ ارانب من كل مجموعة لدراسة جودة الذبيحة وبعض مكونات الدم الكيميائية الحيوية.

وأوضحت النتائج أن هناك زيادة معنوية فى وزن الجسمالمكتسب للمجموعات التجريبية الثانية والثالثة مقيدة التغذية لمدة أسبوع واحد، (فترة قصيرة) مقارنة مع الأرانب حرة التغذية (المجموعة المقارنة). المجموعةالرابعة مقيدة النظام الغذائي خلال الفترة من ٣٣ - ٥٤/٤٠ - ٦١ يوم من العمر (فترة طويلة) سجلت أدنىمعدل فى زيادة الوزن المكتسب مقارنة مع المجموعات التجريبية الأخرى. استهلاك العلف واستهلاك العلف اليومي للمجموعةالرابعة سجلت أقل كمية من استهلاك العلف بنسبة ١٦,٩٪ مقارنة مع المجموعة المقارنة. حدث تحسن فى معامل التحويل الغذائى وانخفاض فى معدل النفوق معنويا لمجموعات التحديد الغذائى.اتحسنت معنويا كل من صفات الذبيحة و نسبة التصافى فى المجموع الرابعة مقيدة التغذية لفترة طويلةمقارنة مع الأرانب حرة التغذية او مقيدة التغذية القصيرة لمدة اسبوع(المجموعة الثانية والثالثة). بينما صفات الذبيحة كان التأثير غير معنوى .التحديد الغذائى ليس له تأثير كبير على خلايا الدم البيضاء بالمقارنة مع مجموعة المقارنة .أظهرت النتائج انخفاض فى عدد كرات الدم الحمراء، وعدد خلايا النيتروفيل وتركيز الهيموغلوبين معنويا مقارنة مع مجموعةالمقارنة يؤدى نظام التحديد الغذائي الى أنخفاض فى تركيزالدهون الكلي، الدهون الثلاثية، الكولسترول، البروتين الكلي وتركيز اليوريا بصورة معنوية مقارنة مع مجموعة المقارنة. أوضح التحليل الكيماوى لمكونات اللحم أنخفاض معنوى فى تركيزالمادة الجافة والبروتين الخام والمستخلص الاثيرى لمجموعات التحديد الغذائى. أدى التحديد الغذائى الى زيادة معنوية وتدريجية فى كثافة اللون وطراوة اللحم في حين زادت قدرة الاحتفاظ بالماءزيادة خطية.

الخلاصة:أوضحت النتائج أن نظام التحديد الغذائي لفترة قصيرة (اسبوع) للأرانب النامية يؤدى الى تحسن فى الأداء الانتاجى و صفات الذبيحة خلال فترة النمو. ويمكن استخدامة كنظام غذائى للأرانب خلال مرحلة النمو.