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EFFECT OF Ca-AMINOPLEX INJECTION ON GROWTH PERFORMANCE OF RABBITS

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ABSTRACT

A total number of 64 New-Zealand white rabbits (32 males + 32 females) aged 6 weeks was randomly divided into 8 groups. Each group was subdivided into 8 replicates (4 males + 4 females) and housed individually in a wire cages located in a controlled environmental temperature house (20 – 25 °C) throughout the experimental period (6-14 wks.). Rabbits were fed ad-libitum on high (17% CP) or low (15% CP) level of crude protein and were injected one, two or three times with Ca-Aminoplex at bi-weekly intervals. Ca-Aminoplex is a solution contains some essential Amino acids, vitamin B complex and calcium. The results revealed the following: -

1- Rabbits fed on high protein level had higher ($P \leq 0.01$) body weight gain compared to those fed on low protein level during the entire experimental period (from 6-14 weeks old).
2- Rabbits injected one, two or three times with Ca-Aminoplex were superior ($P \leq 0.05$) in body weight gain during all experimental period compared to those in the control treatment (not injected).
3- Rabbits fed on the high protein level (17 % CP) consumed higher feed ($P \leq 0.01$) compared to those fed on low protein level (15% CP) all over the experimental period.
4- Injection of growing rabbits two or three times with Ca-Aminoplex enhanced ($P \leq 0.05$) feed consumption all over the experimental period.
5- Rabbits fed on high protein diet had superior ($P \leq 0.05$ or $P \leq 0.01$) cumulative feed conversion ratios compared to those fed on low protein diet all over the experimental period.
6- Rabbits injected one, two or three times with Ca-Aminoplex had better ($P \leq 0.05$) cumulative feed conversion ratios than those un-injected (control) during all studied ages (from 6-14 wks. old).

7- Feeding growing rabbits on the diet of high protein level (17% CP) increased (P≤ 0.01) the cost of feed/rabbit, rabbit price, absolute and relative net revenue and production index compared to those fed on the diet of low protein level (15% CP).
8- Ca-Aminoplex injection increased (P≤ 0.05) the cost of feed/rabbit, but it improved rabbit price, absolute and relative net revenue and production index of growing rabbits.

INTRODUCTION

The cost of feed represents the major cost of production in animal production projects. Dietary crude protein is the most expensive item in diet formulation for rabbits.

The high feed ingredient prices around the world are causing animal nutritionists to search for higher feed utilization to minimize the cost of feed and maximize the profit of animal production. Accordingly, many attempts had been made to decrease these costs to the minimum levels. Therefore, researchers tented to use feed additives which meet the requirements for rapid growth of animals. Feed additives are commonly added to the animals feed to improve their nutritive value, boost animal performance by enhancement of their growth rate, efficient feed utilization, greater livability and lowered mortality. One of these feed additives is Ca-Aminoplex which contains some essential amino acids, water soluble vitamins and calcium. Generally, Ca-Aminoplex is used for both animal and poultry as a calcium solution associated with amino acids and vitamins. It is of great help in case of calcium deficiency, restores the metabolic balance and favors recovery of convalescent animals. It is highly recommended for treating rickets and malnutrition. This drug provides vigor and reconstitutes and supplies energy favoring a rapid recovery.

Rabbits require all amino acids simultaneously to synthesize body protein and other products. Essential amino acids are not synthesized at all, or are synthesized in un-sufficient amount by the body and requiring supplementation from the diet (De Blas and Wiseman, 1998). Also, vitamins B-complex are essential nutrients found in the feeds and not stored in the body, therefore the body needs a continuous supply through a steady daily feed intake. Vitamins B-complex act as co-enzymes that help the body to obtain energy from feeds (Barroeta, *et al.* 2012). Also, they are important for normal appetite, good vision, healthy skin, nervous system and red blood cell formation (Halls, 2010). Moreover, calcium and phosphorus are particularly important for their role in skeletal structure and rabbits need high levels of calcium and phosphorus to allow for bone development during growing and pregnancy periods (Anon, 2011) .

Therefore, the present study was carried out to study the effect of Ca-Aminoplex injection on the growth performance of New-Zealand white rabbits fed on the diets of low or high protein level.

MATERIALS AND METHODS

This study was carried out at the experimental farm of Animal and Poultry production, Faculty of Agriculture, Minia University. It was designed to determine the effect of Ca-Aminoplex injection on the growth performance of growing rabbits fed on diet of high (17% CP) or low (15% CP) level of dietary crude protein.

Experimental animals:

A total number of 64 New-Zealand white rabbits (32 males + 32 females) at age of 6 weeks were randomly divided into 8 groups. Each group was subdivided into 8 replicates (4 males + 4 females) and housed individually in a wire cages located in a controlled environmental temperature house (20°-25°c). The dimensions of the cage were 45×45×38 cm for length, width and height, respectively. All cages were equipped with galvanized feeders and automatic drinkers (nipples). Feed and water were available *ad-libitum* during the experimental period (6-14 wks. of age). Rabbits in all groups were kept under similar managerial and environmental conditions.

Experimental diets:

Two experimental diets were formulated to contain high (17% crude protein) according to **NRC, (1977)** or low (15% crude protein) protein level with almost similar levels of ME (2613 Kcal/kg diet), crude fiber (7%), calcium (1.08%), available phosphorus (0.50%), lysine (0.86%) and methionine + cysteine (0.61%). Feed ingredients and chemical composition of the experimental diets are shown in Table (1).

Growing rabbits in the first, second, third and fourth groups were fed on the diet of high protein level (17% crude protein), while those in the fifth, sixth, seventh and eighth groups were fed on the diet of low protein level (15% crude protein).

Ca-Aminoplex:

Biweekly intramuscular injection with Ca-Aminoplex was used instead of adding vitamin mineral mixture in the diet. Injections with Ca-Aminoplex were carried out as follow:

Rabbits in groups 1 and 5 were not injected with Ca-Aminoplex. Rabbits in groups 2 and 6 were injected one time with 0.5 ml of Ca-Aminoplex at the beginning of the experimental period (at 6 weeks of age). Rabbits in groups 3 and 7 were injected two times with 0.5 ml and 1 ml Ca-Aminoplex at 6 and 8 weeks of age, respectively. Rabbits in groups 4 and 8 were injected three times with 0.5 ml, 1 ml and 1.5 ml Ca-Aminoplex at 6, 8 and 10 weeks of age, respectively.

Injection doses were determined by the calculation involved in the Ca-Aminoplex pamphlet. The calculation is depended on species, age and body weight of the animals. The composition of Ca-Aminoplex is shown in Table (2).

Growth parameters:

Live body weight gain:

Live body weight for each replicate was recorded to the nearest gram at bi-weekly intervals throughout the experimental period from 6-14 weeks of age. Live body

weight gain for each replicate was calculated by subtracting the initial live weight of a certain period from the final live weight at the same period.

Feed consumption:

Feed consumption for each replicate was calculated at bi-weekly intervals by subtracting remainder feed from the offered feed. Cumulative feed consumption for each replicate was calculated during the period from 6-14 weeks of age.

Feed Conversion ratio:

Feed conversion ratio was calculated for each replicate as the amount of feed required to produce one-unit body weight gain at a certain period (gm. feed consumption/ gm. body weight gain).

Cumulative feed conversion ratio was calculated during the period from 6-14 weeks of age using the following equation:

$$\text{Cumulative feed conversation ratio} = \frac{\text{Cumulative feed consumption/ replicates at a certain period}}{\text{Cumulative body weight gain/ replicates at the same period}}$$

Cost of diet and economic return:

Total cost of kilogram feed for low and high crude protein diet, cost of Ca-Aminoplex, cost of feed/gain/rabbit and selling price/gain/rabbit were calculated at the end of the growing period (at 14 weeks of age) on the basis of the price of feed ingredient and selling price of rabbits in the local market.

The absolute economic returns were calculated as follow:

Selling price/gain/rabbit — total cost of feed + injection/rabbit

$$\frac{selling\ price/gain/rabbit}{total\ cost\ of\ feed + injection/rabbit}$$

The relative economic returns were calculated in relation to the control treatment. Production index (PI) for each dietary treatment was calculated as follow:

$$PI = \frac{Body\ weight\ gain\ (kg)}{Feed\ conversion\ ratio} \times 100$$

Statistical Analysis:

Data were statistically analyzed using the general linear model procedures of **SAS (2006).**

Mean differences among treatments were tested by Duncan Multiple Range Test **(Duncan, 1955).**

Results and Discussion

1. Body weight gain: -

1.1. Effect of protein level

Averages of cumulative body weight gain of growing New-Zealand White rabbits during the period from 6-14 weeks of age as affected by protein level, Ca-Aminoplex and their interaction are shown in Table (3). Protein level had highly significant effect ($P \leq 0.01$) on cumulative body weight gain at the end of the experimental period from 6-14 weeks of age. Rabbits fed on the diet of high protein level recorded higher ($P \leq 0.01$) cumulative body weight gain than those fed on the low protein diet during the period from 6-14 weeks of age. The superiority in cumulative body weight gain of growing rabbits represented about 8.62% at the end of the experimental period. The higher body weight gain recorded for rabbits fed on the high protein diet could be

due to the higher (P≤ 0.01) feed consumption and better feed conversion ratio (Table 3). However, Yassein, *et al* (2011) attributed the improvement in body weight gain of rabbits fed high dietary protein to the amount of crude protein consumed, since the protein is the most essential nutrient.

These results agree with those reported by Omole, (1977); De Blas, *et al* (1981); Maertens, *et al* (1997); Li, *et al* (2002); Ladokun, *et al* (2006); Yassein, *et al* (2011); Xuepeng, *et al* (2012); Ramadan, (2013); Trocino, *et al* (2013) and Gihan, (2017) who concluded that, the average of body weight gain of rabbits was significantly enhanced by the increase in CP level.

1.2. Effect of Ca-Aminoplex

The effect of Ca-Aminoplex on cumulative body weight gain of growing rabbits was highly (P≤ 0.01) significant during the period from 6-14 weeks of age. During this period of age, rabbits injected three times with Ca-Aminoplex had the highest (P≤ 0.05) cumulative body weight gain followed by those injected two or one times respectively compared to those un injected (control).

From these results, it was noticed that, injection of rabbits with Ca-Aminoplex one, two or three times improved cumulative body weight gain by about 4.94%, 13.99% and 20.26%, respectively at the end of the experimental period (at 14 wks. of age). Therefore, it's recommended to repeat Ca-Aminoplex injection at bi-weekly intervals to maximize cumulative body weight gain of growing rabbits.

The positive effect of Ca-Aminoplex on body weight gain of growing rabbits could be attributed to its content of essential amino acids, vitamin B complex and calcium. Growth rate of rabbits was markedly enhanced by addition of vitamin B_6 (Gihan, 2017), lysine (Taboada, *et al*, 1994 and Jing and Lifu, 2010), methionine (Al-Homidan, 2001; Zhang and Li, 2010 and Yesmin, *et al*, 2013). Also, Osman *et al*, (2007) indicated that, broiler chicks must be injected at least two times with Ca-Aminoplex to maximize its profitability.

There was insignificant positive effect of the interaction (protein level × Ca-Aminoplex) on cumulative body weight gain at the end of the experimental period (6-14 weeks of age). The insignificant improvement in body weight gain of growing rabbits injected two or three times with Ca-Aminoplex was more obviously in rabbits fed the low protein level than those fed the high protein level at the end of the experimental period.

2. Cumulative feed consumption:

2.1. Effect of protein level:

Averages of cumulative feed consumption of growing New-Zealand White rabbits as affected by protein level, Ca-Aminoplex and their interaction are presented in Table (3). Level of protein had highly (P≤ 0.01) significant effect on cumulative feed consumption of rabbits during the entire experimental period (6-14 weeks old). Increasing protein level in the diet improved (P≤ 0.01) cumulative feed consumption of rabbits. This increase represented

about 7.09% over those fed on the low protein level during whole experimental period (6-14 wks. old). The increase in cumulative feed consumption of growing rabbits fed on the diet of high protein level may be due to the improvement in palatability or to the increase in passage rate of the digesta in the digestive tract compared to those fed on the diet of low protein level.

These results agree with the results reported by Omole, (1977); Maertens, *et al* (1997); Yassein, *et al* (2011) and Ramadan, (2013), who concluded that, rabbits fed on the diet of high protein level consumed more feed compared to those fed on the diet of low protein level during the growing period.

2.2. Effect of Ca-Aminoplex:

Injection of Ca-Aminoplex had highly significant ($P \leq 0.01$) effect on cumulative feed consumption of growing rabbits (Table 3) during the period from 6-14 weeks of age (end of the experiment). During the period from 6-14 weeks of age, rabbits injected three times with Ca-Aminoplex achieved the highest ($P \leq 0.05$) cumulative feed consumption followed by those injected two times. There was no significant difference in cumulative feed consumption between rabbits injected one time with Ca-Aminoplex and those in the control group during the period from 6-14 weeks of age. The increase in cumulative feed consumption of rabbits injected two or three times with Ca-Aminoplex represented about 6.09% and 11.19%, respectively compared to those un injected (control) at the end of the experimental period (14 weeks of age). The positive effect of Ca-Aminoplex on feed consumption of growing rabbits could be attributed to its content of essential amino acids, vitamin B-complex and calcium.

From these results, it could be concluded that, injection of growing rabbits with Ca-Aminoplex enhanced feed consumption and it was preferable to repeat injection at bi-weekly intervals to maximize the amount of feed consumed due to the fact that, vitamin B-complex is not stored in the body. It is well known that, vitamin B-complex enhance feed consumption of rabbits.

These results agree with those observed by Osman, *et al* (2007) who indicated that, broiler chicks injected two or three times with Ca-Aminoplex recorded the highest feed consumption. Also, feed consumption of rabbits was significantly increased when they were fed diets supplemented with commercial mineral blocks contained 12% calcium, trace elements (Cu, Mn, Zn and Se), 1.5% total phosphorus and 2% sodium (Zerrouki, *et al*, 2008), lysine (Parigi-Bini, *et al*, 1988; Scapinello, *et al*, 1995 and Jing and Lifu, (2010)) and methionine (Yesmin, *et al*, 2013). Zerrouki, *et al* (2008) indicated that, the positive effect of the mineral blocks addition was most probably a consequence of the calcium deficiency alleviation.

The effect of the interaction between protein level and Ca-Aminoplex on cumulative feed consumption of growing rabbits was significant ($P \leq 0.05$) during the period from 6-14 weeks of age. This

indicated that, the effect of Ca-Aminoplex on cumulative feed consumption of growing rabbits depends on the level of protein in the diet and vice versa, also on the frequency of Ca-Aminoplex injection. Meanwhile, the effect of Ca-Aminoplex injection and its repeatability on cumulative feed consumption were more pronounced when rabbits were fed on the low protein level during the whole growing period (6-14 wks. old). The enhancement in feed consumption of rabbits injected one, two and three times with Ca-Aminoplex represented about 2.08% vs 0.69%, 4.76% vs 7.55% and 8.46% vs 14.16%, respectively when rabbits were fed high vs low protein level during the entire experimental period (6-14 wks. old).

3. Cumulative feed conversion ratio: -

3.1. Effect of protein level

The effect of protein level, Ca-Aminoplex and their interaction on cumulative feed conversion ratio of growing rabbits during the period from 6-14 weeks of age are shown in Table (3). Protein level had highly significant ($P\leq 0.01$) effect on cumulative feed conversion ratios of growing rabbits during the period from 6-14 weeks of age. Growing rabbits fed on the diet of high protein level recorded better ($P\leq 0.01$) cumulative feed conversion ratios than those fed on the diet of low protein level. The improvement in cumulative feed conversion ratio represented about 1.57% compared to those fed on low protein level at the end of the experimental period (14 weeks old).

This indicated that, growing rabbits utilized feed more efficiently when fed the diet of high protein level than those fed on the diet of low protein level. It is well known that, younger rabbits had faster growth rate and need more dietary protein to convert into body gain.

Similar results were obtained by Omole, (1977); Lei, *et al* (2004); Xuepeng, *et al* (2012); Trocino, *et al* (2013) and Gihan, (2017) who concluded that, feed utilization indicator was significantly enhanced when rabbits were fed on high dietary protein levels. On the other hand, García-Palomares, *et al* (2006), Yassein, *et al* (2011), Ramadan, (2013) and Hemid, *et al* (2015) indicated that rabbits fed on the diet of 14% CP recorded better feed conversion ratio during all studied ages (from 25-81 days of age).

3.2. Effect of Ca-Aminoplex

The effect of Ca-Aminoplex on cumulative feed conversion ratios was highly significant ($P\leq 0.01$) during the period from 6-14 weeks of age (Table 3). During the entire experimental periods (6-14 weeks old), growing rabbits injected two and three times with Ca-Aminoplex recorded the best ($P\leq 0.05$) cumulative feed conversion ratios followed by those injected one time. The improvement in cumulative feed conversion ratio of growing rabbits resulted with Ca-Aminoplex injection one, two or three times was about 3.44%, 6.98% and 7.59%, respectively compared to those un injected (control) during the whole

experimental period (6-14 weeks of age).

From these results, it was concluded that, growing rabbits could be injected at least two times with Ca-Aminoplex at 6 and 8 weeks of age to obtain better cumulative feed conversion ratios. The improvements in cumulative feed conversion ratio resulted from Ca-Aminoplex injection may be due to its contents of essential amino acids, vitamin B-complex and calcium needed for better metabolism.

These results are in harmony with those reported by **Osman *et al* (2007)** who observed that, broiler chicks injected two or three times with Ca-Aminoplex had better feed conversion ratio.

In this respect, many investigators indicated that, feed conversion ratio of rabbits was improved with increasing dietary lysine (Parigi-Bini, *et al*, 1988; Scapinello, *et al*, 1995 and Jing and Lifu, 2010) and dietary methionine (Sonbol, *et al*, 1992; Bhatt, *et al*, 1997 and Yesmin, *et al*, 2013).

Also, Zerrouki, *et al* (2008) indicated that the positive effect of mineral blocks contained 12% calcium, trace elements (Cu, Mn, Zn and Se), few total phosphorus (1.5%) and sodium (2%) to rabbit diets was most probably a consequence of the calcium deficiency alleviation. Moreover, Isabel, *et al* (2012) indicated that, vitamin B_6 was essential for amino acids metabolism, while Halls, (2010) reported that, vitamin B_1, B_5 and phosphorus were essential for energy metabolism from carbohydrate and fats.

The effect of the interaction (protein level × Ca-Aminoplex) on cumulative feed conversion ratios of growing rabbits was insignificant ($P \geq 0.05$) during the entire experimental period from 6-14 weeks old.

From these results, it was noticed that, injection with Ca-Aminoplex improved cumulative feed conversion ratios of growing rabbits fed on either high or low protein level, and alleviate the negative effect of feeding rabbits on the diet of low protein level during the early stage of life after weaning.

4. Economic efficiency and production index:

4.1. Effect of protein level:

Averages of feed cost, selling price/weight gain/rabbit, absolute and relative net revenue and production index of growing rabbits as affected by protein level, Ca-Aminoplex and their interaction are presented in Table (4). Protein level had highly significant ($P \leq 0.01$) effect on feed cost, absolute and relative net revenue and production index of growing rabbits. Rabbits fed on high dietary protein had significantly ($P \leq 0.01$) higher feed cost, price/rabbit gain, absolute and relative net revenue and production index compared to those fed on low protein level. Growing rabbits fed on high dietary protein level recorded higher ($P \leq 0.01$) relative net revenue and production index by about 4.69% and 3.54%, respectively in spite of its higher feed cost (21.82 vs 19.02 LE).

The improvement in net revenue and production index of rabbits fed high dietary protein could be attributed to the higher body weight

gain and better feed conversion ratio (Table 3).

These results agree with those reported by Sohair, (1984) who indicated that, economic efficiency values of broiler chicks were gradually decreased as the C/P ratio widened beyond the level of 136-144 Kcal ME/ 1% CP. Also, Abd El-Samee, (2001) found that, feeding broiler chicks on optimum level of CP increased net revenue and economic efficiency values compared with the low level of CP. Moreover, Abd El-Fattah, (2002) reported that, economic return was decreased by decreasing the CP content in the diet of broiler chicks. However, Hemid, *et al* (2015) pointed out that, rabbits fed on low protein level (14% CP) recorded higher ($P \geq 0.05$) economic efficiency%, production index (PI) and production efficiency factor (PEF) compared to those fed on high dietary protein level (16% CP).

4.2. Effect of Ca-Aminoplex:

Ca-Aminoplex injection had highly ($P \leq 0.01$) significant effect on feed cost, selling price/weight gain/rabbit, absolute and relative net revenue and production index of growing rabbits (Table 4). Injection of rabbits with Ca-Aminoplex progressively increased ($P \leq 0.05$) feed cost/ rabbit. However, rabbits injected three times with Ca-Aminoplex recorded the highest ($P \leq 0.05$) net revenue and production index followed by those injected two times. Also, rabbits injected one time with Ca-Aminoplex had higher ($P \leq 0.05$) net revenue and production index compared to those not injected (control). Rabbits injected one, two and three times with Ca-Aminoplex achieved higher ($P \leq 0.05$) net revenue by about 7.07%, 18.59% and 24.92% respectively over those not injected (control). Also, rabbits injected one, two and three times with Ca-Aminoplex recorded higher ($P \leq 0.05$) production index by about 2.73%, 7.17% and 9.59% respectively over rabbits not injected (control).

The superiority of injected rabbits with Ca-Aminoplex in net revenue and production index over those not injected (control) could be due to their higher body weight gain and better ($P \leq 0.05$) feed conversion ratios (Table 3).

From these results, it could be concluded that, intramuscular injection with Ca-Aminoplex improved net revenue and production index of growing rabbits by about 16.86% and 6.50%, respectively compared to those un injected (control). Similar results were observed by Osman, *et al* (2007) who reported that injection of broiler chicks with Ca-Aminoplex two or three times significantly increased the cost of feed/bird at marketing age and recorded the highest net revenue compared to the control group (not injected).

The effect of the interaction between protein level and Ca-Aminoplex injection on net revenue and production index was insignificant (Table 4). This indicate that the positive response of rabbits fed on either high or low protein level to Ca-Aminoplex injection was almost similar.

There is no enough information in the literature on the effect of Ca-Aminoplex injection on the economic efficiency of growing rabbits.

Table (1): The composition and chemical analysis of the experimental diets of growing New-Zealand White rabbits.

Ingredients	Recommended	Low protein
Yellow corn	57.00	59.90
Soya-bean meal	21.60	15.25
Wheat bran	5.38	6.51
Limestone	1.00	1.00
Clover hay	12.77	15.00
Di-calcium phosphate	1.90	1.90
Salt	0.30	0.30
Methionine	0.05	0.10
Lysine	0.00	0.04
Total	100	100
Calculated analyses%		
Crude protein	17.00	15.01
ME (Kcal/ kg)	2612.97	2612.97
Crude fiber	6.73	7.02
Calcium	1.08	1.09
Available phosphorus	0.50	0.50
Methionine+ cysteine	0.60	0.60
Lysine	0.75	0.75

Table (2): The composition of Ca-Aminoplex each 100 ml

Component	The quantity
Calcium gluconate	24 gm.
Boric acid	4.8 gm.
D-Glucose	6 gm.
Vitamin B_1 (Thiamine)	20 mg.
Vitamin B_2 (Riboflavin)	8 mg.
Vitamin B_3 (Niacin)(Nicotinamide)	8 mg.
Vitamin B_5 (Pantothenic acid)	100 mg.
Vitamin B_6 (Pyridoxine)	20 mg.
Essential Amino acids	10 mg.
DL- Methionine	0.001 gm.
L- Lysine chloride	0.003 gm.
L- Phenyl alanine	0.001 gm.
L- Leucine	0.002 gm.
DL- Tryptophan	0.001 gm.
L- Valine	0.001 gm.
L- Cystein chloride mono hydrate	0.001 gm.

Amino, CABALLOS, Complementos, GANADO, MASCOTAS, PORCINOS, TORNEL. Reg.S.A.G.A.R.P.A.Q:1069-019.

Table (3): Effect of protein level, Ca-Aminoplex, and their interaction on growth performance of growing rabbits at 6-14 weeks of age

Treatment	Body weight gain (gm.) ± SE:	Cumulative feed consumption (gm.) ± SE:	Cumulative feed conversion (gm.) ± SE:
Protein level (CP)	**	**	**
High (H.)	1366.0^{a}	4850.3^{a}	3.557^{b}
Low (L.)	1257.6^{b}	4529.3^{b}	3.613^{a}
SE	7.57	24.00	0.011
Ca-Aminoplex injection	**	**	**
Without (Control)	1194.8^{d}	4480.4^{c}	3.754^{a}
One time	1253.8^{c}	4543.8^{c}	3.625^{b}
Two times	1361.9^{b}	4753.4^{b}	3.492^{c}
Three times	1436.9^{a}	4981.6^{a}	3.469^{c}
SE	10.70	33.95	0.016
Ca-Aminoplex × CP	NS	*	NS
H. without Injection	1262.1	4671.6^{cd}	3.702
H. one time	1320.8	4769.0^{cb}	3.611
H. two times	1401.4	4893.9^{b}	3.492
H. three times	1479.9	5066.9^{a}	3.425
L. without injection	1127.4	4289.1^{e}	3.807
L. one time	1186.9	4318.6^{e}	3.639
L. two times	1322.4	4613.0^{d}	3.492
L. three times	1393.9	4896.3^{b}	3.513
SE	15.13	48.01	0.022

NS not significant, * significant at 5% level, ** significant at 1% level
In the same classification, means within each column(s) having different superscripts(s) are significantly different ($P \leq 0.05$)
± SE= Standard error of the means

Table (4): Effect of protein level, Ca-Aminoplex, and their interaction on the cost of feed/rabbit + Ca-Aminoplex injection, rabbit price, net revenue and relative economic efficiency of rabbits.

Treatment	Cost of feed/rabbit (LE)	Rabbit price (LE)	Net revenue (LE)	Relative Economic efficiency	Production index
Protein level (CP)	**	**	**	**	**
High (H.)	21.82[a]	54..64[a]	32.82[a]	100.00[a]	38.51[a]
Low (L.)	19.02[b]	50.31[b]	31.28[b]	95.31[b]	34.97[b]
SE	0.101	0.303	0.226	0.827	0.29
Ca-Aminoplex injection	**	**	**	**	**
Without (Control)	19.34[c]	47.79[d]	28.45[d]	100.00[c]	31.87[d]
One time	19.69[c]	50.15[c]	30.46[c]	105.34[b]	34.60[c]
Two times	20.73[b]	54.48[b]	33.74[b]	110.77[a]	39.04[b]
Three times	21.93[a]	57.48[a]	35.54[a]	110.10[a]	41.46[a]
SE	0.143	0.428	0.319	1.170	0.41
Ca-Aminoplex × CP	NS	NS	NS	NS	NS
H. without Injection	20.84	50.49	29.65	100.00	34.1
H. one time	21.35	52.83	31.48	103.66	36.58
H. two times	22.06	56.06	33.10	108.43	40.15
H. three times	23.05	59.20	36.14	110.22	43.23
L. without injection	17.84	45.10	27.26	107.35	29.64
L. one time	18.03	47.48	29.44	114.77	32.62
L. two times	19.41	52.90	33.49	121.27	37.94
L. three times	20.81	55.76	34.94	118.08	39.96
SE	0.203	0.605	0.451	1.655	0.57

NS not significant, * significant at 5% level, ** significant at 1% level
In the same classification, means within each column(s) having different letter(s) are significantly different ($P \leq 0.05$)
± SE= Standard error of the means

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تأثير الكالسيوم امينوبليكس على الأداء الإنتاجي للأرانب النامية

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استخدم في هذه الدراسة 64 أرانب نيوزيلندي ابيض (32 ذكر+ 32 أنثى) عند عمر 6 أسابيع تم تقسيمهم عشوائيا إلى 8 مجموعات بكل مجموعة 8 مكررات (4 ذكور + 4 إناث) وتم إسكان الأرانب بشكل فردي في بطاريات من السلك بعنبر مكيف الهواء (20– 25°م).
تم تغذيه الأرانب لحد الشبع على عليقتين احتوت الأولى على مستوى عالي من البروتين الخام (17٪) والأخرى على مستوى منخفض من البروتين الخام (15٪).

تم حقن الأرانب بمحلول الكالسيوم امينوبليكس مره واحده أو مرتين أو ثلاث مرات في أعمار 6، 8، 10 أسابيع ويحتوي الكالسيوم امينوبليكس على معظم الأحماض الأمينية الأساسية ومجموعه فيتامين ب المركب والكالسيوم والفسفور وقد أوضحت النتائج ما يلي:

1. حققت للأرانب المغذاة على العليقة المرتفعة في البروتين معدل زيادة تراكمي في وزن الجسم أعلى معنويا (1%) عن تلك المغذاة على العليقة المنخفضة في البروتين عند عمر 14 أسبوع.
2. تفوقت الأرانب التي تم حقنها بالكالسيوم امينوبليكس لمرة، مرتين أو ثلاث مرات في معدل الزيادة التراكمي في وزن الجسم مقارنة بالأرانب التي لم يتم حقنها (معامله المقارنة) عند عمر 14 أسبوع.
3. استهلكت الأرانب المغذاة على العليقة المرتفعة في نسبه البروتين الخام كميه عليقه تراكمية أكثر من تلك المغذاة على العليقة المنخفضة في نسبه البروتين الخام في نهاية التجربة (عند عمر 14 أسبوع).
4. أدى حقن الأرانب النامية بالكالسيوم امينوبليكس مرتين أو ثلاث مرات إلي زيادة في كميه العليقة التراكمية المستهلكة.
5. تفوقت الأرانب المغذاة على العليقة المرتفعة في نسبه البروتين في معدل التحويل الغذائي التراكمي مقارنه بتلك المغذاة على العليقة المنخفضة في نسبه البروتين.
6. أدى حقن الأرانب بالكالسيوم امينوبليكس مره واحده أو مرتين أو ثلاث مرات إلى تحسن جوهري في معدل التحويل الغذائي التراكمي عند عمر 14 أسبوع.
7. أدت تغذيه الأرانب النامية على العليقة المرتفعة في نسبه البروتين الخام إلى زيادة تكلفه التغذية، وسعر بيع الأرنب، والعائد النسبي والمطلق ودليل الإنتاج مقارنة بالأرانب المغذاة على العليقة المنخفضة في نسبه البروتين الخام.
8. أدى حقن الأرانب النامية بالكالسيوم امينوبليكس إلي زيادة في تكلفه التغذية، وسعر بيع الأرنب، والعائد النسبي والمطلق ودليل الإنتاج مقارنه بمعامله الكنترول.