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EFFECT OF CAFFEINE ADMINISTRATION ON MILK YEILD OF DOE RABBITS.

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ABSTRACT

The present study was aimed to evaluate the effect of caffeine to improve productive efficiency and milk yield of doe rabbits. A total number of 40 adults NZW doe rabbits were divided into four groups (10 each). The first group was given pure water as a control (untreated), while the second, third and fourth groups were given, (250 mg, 500 mg and 750 mg caffeine/liter of drinking water), respectively for 21 days prior to natural mating. Kindling rate, litter size at birth and weaning, sex ratio and milk production were recorded. Milk and plasma components analysis were determined. Kindling rate, liter size at birth and weaning, milk yield and female rate were increased significantly ($P \leq 0.05$) in the third than control group. Milk fat (gm/dl) was significantly ($P \leq 0.05$) higher in the control than treatment groups, while milk total protein, lactose and plasma total protein were significantly ($P \leq 0.05$) higher than the control group. While AST, ALT enzymes, cholesterol and progesterone hormone were not differed. However, estradiol-17β hormone in the second group was significantly ($P \leq 0.05$) higher than other groups. Practically, it could be recommended that a level (500 mg / liter drinking water) of caffeine is an appropriate supplement for improving reproductive abilities and the economic efficiency of doe rabbits.

Keywords: Rabbits, Caffeine, Milk, Blood.

INTRODUCTION

Productivity is the key to growth and reproduction is the backbone of animal production. In addition, rabbits are mammals with a great economic value, where they consume small amount of food to produce meat with a higher percentage of protein (20%) and good taste. Rabbit meat is easy to digest, has lees fat (11-20%) and less caloric value (795) and rich with minerals (Hanan *et al*., 2019). Caffeine is a methylxanthine occurring naturally in more than 50 species of plant. In its processed form it is present in many foods and pharmaceutical products (Nikolic *et al*., 2003).
Caffeine administration before birth improves the vitality and respiratory capacity of piglets, increasing their adaptation to extra-uterine environment (Sanchez *et al*., 2019). Hoy and Selzer, (2002) found that, the newborn rabbits stay in the nest box until 17-20 day of life and rabbit females usually go into the nest only once a day and milk yield control is quite easy during this period, weighing females before and after milking.

The objective of this study was to investigate the effect of caffeine administration during pregnancy on milk production, litter size, and blood biochemical of NZW doe rabbits.

MATERIALS AND METHODS

Animal and experimental design: The experimental work was carried out at the Rabbitry Farm of Sakha Research Station, belonging Animal Production Research Institute, Egypt.

A total of 40 NZW doe rabbits were used in this study. Doe rabbits were nulliparous, averaging 5– 6 months of age and 2.850 – 3.150 kg Rabbits were randomly divided into four equal treatment groups (10 each) according to caffeine administration. First group was used without caffeine administration (control). The second, third and fourth groups were administrated with caffeine at levels of 250 mg, 500 mg and 750 mg / liter of drinking water, respectively. Doe rabbits in all groups were allowed to be naturally mated by fertile bucks and pregnancy was diagnosed by palpation on day 10 post-mating to detect the pregnancy. Kindling rate, litter size at birth, 21 days and weaning, sex ratio and milk production at 7, 21 days and weaning were calculated.

Analytical methods:
Blood samples: They were taken 21 days of caffeine administration from ear vein of 3 does in each group into test tubes containing EDTA as anticoagulant before morning feeding, then centrifuged at 700 *g* for 15 min to separate blood plasma, which was stored at -20 C° until determination of total proteins (Cornall *et al.*, 1949), albumin (Weichselaum, 1946), cholesterol (Watson, 1960), AST and ALT activity (Reitman and Frankal, 1957) was determined in plasma using commercial kits and spectrophotometer. However, globulin level was obtained by the difference between total protein and albumin levels. Also, progesterone (P4) and estrogen (E2) concentrations determined according to Ross *et al*. (1981) using commercial kit (Oxis International, Inc. 323 Vintage Park Dr. Foster City, CA 94404). The assay sensitivity, expressed as the value of 2 standard deviations below maximum binding (zero standard), was 0-3 ng/ml for P4 and 0-30 ng/ml for E2.

Milk sampling: The teats were pulled immediately between the thumb and forefinger to express several milliliters of milk per gland into a glass vial. Milk yield was recorded on days 7, 21 and 28 (weaning) of suckling period (Lebas, 1968). Average milk volume of about 5 ml was obtained from 3 does on 21 days of lactation period. Samples were frozen and stored until analyzed for fat, crud protein, lactose, ash and dry matter according to (AOAC 1990).

Statistical Analysis:
Data were statistical analyzed by of variance according to (SAS 2002). Comparisons among means were separated by Duncan's multiple rang test (Duncan, 1955).

RESULTS AND DISCUSSION

The kindling rate, litter size at birth, 21 days and weaning, sex ratio increased females and milk yield g / day per doe at 21 days during lactation period were significantly ($P \leq 0.05$) higher, in the third group than control group (Table 1)**.**

The obtained results are in agreement with those of (Bodnar, 1998), caffeine administration improved the conception rate in rabbits. El-Kelawy *et al*. (1996) found also that caffeine administration during pregnancy improved milk production rabbits. Robertson *et al*. (2018) suggested that feeding caffeine to ewes can improve the survival of their lambs where found that, lamb mortality of marketing was reduced from 30% to 9%. These beneficial effects would be a consequence of caffeine anti-inflammatory effects, which may improve immune function (Horrigan *et al*., 2006).

Results demonstrated that milk production on day 21 of lactation was higher in rabbits treated with caffeine (Table 1). Lactation is a crucial period, not only for survival, but also to achieve a suitable performance and maturity degree at weaning time (El-Kelawy et al., 1996; García-Quirós *et al*., 2014). Sheffield (1991) suggested that the increased in lactation performance when caffeine was administered to the mice may be due to the increase in mammary developmental capacity during pregnancy. Moreover, Tucker (1981) also added that the total secretory capacity of the mammary gland was greater in caffeine fed mice.

Table 1: Effect of caffeine administration on average of kindling rate, litter size, sex ratio and milk yield of NZW rabbit does.

Experimental group	N	Kind. Rate	Total litter size/doe			Kid sex at 28 day		Milk yield (g/doe)		
			Birth	21 day	28 day	Male	Female	7 day	21 day	28 day
G1 (control)	10	70^{b}	6.9^{b}	5.1^{c}	4.9^{c}	2.5^{b}	2.4^{b}	81.2^{b}	150.5^{c}	104.0^{b}
G2 (250 mg/L)	10	80^{ab}	8.9^{a}	6.4^{b}	6.0^{b}	2.4^{b}	3.6^{a}	85.3^{ab}	173.0^{b}	113.0^{a}
G3 (500 mg/L)	10	90^{a}	9.9^{a}	8.0^{a}	7.4^{a}	3.3^{a}	4.1^{a}	93.4^{a}	208.0^{a}	121.0^{a}
G4 (750 mg/L)	10	80^{ab}	6.5^{b}	6.1^{b}	6.0^{b}	2.6^{ab}	3.4^{a}	78.0^{b}	212.0^{a}	117.0^{a}
±S.E.	-	-	0.49	0.33	0.35	0.25	0.30	3.92	7.52	3.03
Significance	-	*	**	**	**	*	*	*	***	**

[a, b, c] Means within the same column with different superscripts are significantly different at P≤0.05. N: Number of doe rabbits. Kind. Rate: Kindling rate. NS: Not significant. * Significant at P<0.05. ** Significant at P<0.01. *** Significant at P<0.001.

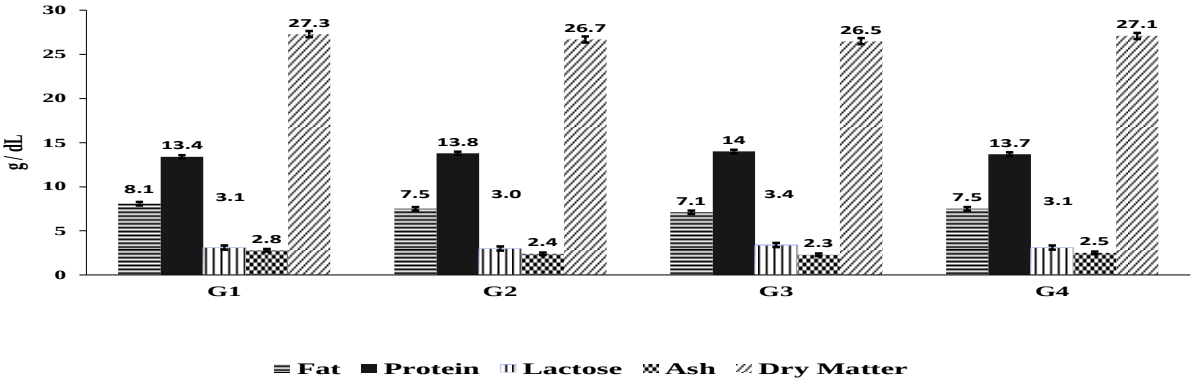

Figure 1 : Effect of caffeine administration on milk composition in NZW doe rabbits at 21 days of lactation period.

The results of the present work in (Figure 1), also indicated that averages of milk composition at 21 day of Fat, Protein, Lactose, Ash and Dry matter in NZW doe rabbits were not affected by caffeine administration. However, Fat was higher (8.1 ±0.2) in control group than treated groups (7.5± 0.2, 7.1±0.2, 7.5±0.2 in G2, G3 and G4 respectively, P ≤ 0.05).

Data presented in (Table 2) show that total protein (TP), Albumin (ALB), Globulin (GLB), Cholesterol (Chol.), Aspartate transaminase (AST), Alanine transaminase (ALT) and Progesterone (P_4) were not significantly affected by treatment (P≤0.05).

Table 2: Effect of caffeine administration on average of biochemical, enzyme activity and reproductive hormones in blood plasma of NZW rabbit does.

Groups	T. proteins g/dl	Albumin g/dl	Globulin g/dl	Cholesterol mg/dl	AST U/L	ALT U/L	Progesterone ng/ml	Estrogen ng/ ml
G1 (control)	6.29	3.30	2.90	68.03	63.95	44.30	1.3	25.3^{b}
G2 (250mg/L)	6.36	3.17	3.19	76.70	66.00	46.03	1.5	29.3^{a}
G3 (500mg/L)	6.60	3.50	3.10	77.80	67.70	45.30	1.7	27.7^{ab}
G4 (750 g/L)	6.67	3.30	3.30	79.60	68.00	44.40	1.9	26.7^{b}
±S.E.	0.11	0.12	0.15	3.68	1.9	1.2	0.15	1.96
Significance	NS	NS	NS	NS	NS	NS	NS	*

[a and b] Means within the same column with different superscripts are significantly different at P≤0.05. N: Number of doe rabbits. NS: Not significant. * Significant at P<0.05. ** Significant at P<0.01. *** Significant at P<0.001

These results contrast with those of Akande and Banjoko (2011) and Nabofa and Alada (2018), they found serum levels of ALT and AST elevated after caffeine treatment in mouse and rabbits,

respectively. On the other hand, Oluwakemi *et al*. (2017) showed total level of cholesterol and triglyceride were increased after caffeine administration in rabbits. The progesterone levels are not different between groups. While, serum estrogen levels (E_2) were significantly higher in G2 group. Caffeine administration had poor effects in steroid hormones.

CONCLUSION

In conclusion, supplementing drinking water with caffeine (500 mg/L) for rabbit does, 20 day before mating up to weaning, is an appropriate tool for improving milk yield and composition, and litter size at weaning.

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