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RESEARCH ARTICLE

The effect of dietary doum supplementation on productive and reproductive performance of does rabbits in Upper Egypt

Hassanien, H.H.M.[2], A.A. Baiomy[1], H.A. Hassan[1] and H. Badry[1]*

[1]Animal and Poultry Department, Faculty of Agriculture, South valley University, Qena, Egypt

[2]Animal and Poultry Production Department, Faculty of Agriculture, Beni Suef University, Egypt

Abstract

The objective of this work was to study the effect of Doum *(Hyphaenethebaica)* supplementation on productive and reproductive performance of rabbit does in Upper Egypt during spring season. A total of 6 months old 160 does including 80 California (CAL) and 80 Newzland (NEZ) rabbits with average initial body weight 3.150±0.05 kg was randomly divided into four groups of 20 does each/breed (CAL or NEZ). The study was conducted in a 4×2 factorial design. Doum in the basal diet was supplemented for each strain with 4 levels 0, 0.3, 0.6, 0.9 g doum kg diet and offered to 2 rabbit breeds New Zealand White (NZW) and Californian (CAL) in upper Egypt. Doum in the basal diet was improved performances of rabbits compared to control. California does show significant higher productive and reproductive performances and lower mortality rate compared to the NEZ breed.

Keywords: Doum, Reproductive, Fertility, Milk , Female rabbits.

Introduction

The World Health Organization has encouraged research on medicinal plants as ant diabetics (Shehu *et al*., 2014) and (Abdel-Rahim *et al*., 2011). Doum (*Hyphaenethebaica*) is an African palm tree, common in Upper Egypt (Aremu, 2011), originated from Nile valley an edible fruit which is glubose-quandrangular , about 6 x 5 cm with a shiny orange-brown to deep chestnut skin (epicarp).The rind (mesocarp) in some palm is inedible but of other it is very palatable , highly aromatic and sweet with a taste like ginger bread hence the English name. When eaten it serves as vermifuges and parasite expellant (Burkill,1997). The chloroform extract of this fruit also improves spermatic count in male rats at low concentration (Hetta and Yassin 2006) and but decreases it at high concentration (Hetta *et al.,* 2005).It was considered sacred by the Ancient Egyptians and its seeds were found in many pharaoh's tombs e.g Tutankhamun's tomb (Hetta *et al.,* 2005). many researches have been conducted to explore the use of phytogenic as alternative to antibiotic in animal nutrition (Abdel-Wareth et al., 2012; 2014; 2018; 2019; 2020; Abdel-Wareth, 2016; Fawaz et al., 2019; Amer et al., 2020). Mervat Ghazal, (2016) showed that, Hy-Plus rabbit does fed diets supplemented with doum using bucks treated with the same treatment, recorded conception and kindling rates; litter size and weight and bunny weight at birth and at weaning significantly , and in descending order, than of those recorded by does fed un-supplemented

***Corresponding author: Hanan Badry**
Email: nona.kind84@gmail.com
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diet.Also, it can be noticed that doum supplementation supplementation reduces abortion and mortality rate. It is clear from above studies that, the fertilizing ability of rabbit semen treated with doum show better results. Also, improving the survivability due to transfer of active material in it (Zn, Mn and copper) which can be used as antioxidant and antimicrobial to the milk of does to the bunny, so the bunny get healthy and its immune system improved and disease resistance increased which reflect on decreasing the mortality rate and improve the fertility rate, litter size and weight and individual weight, even at birth or at weaning(Mervat Ghazal 2016). Ali and Ghazal (2013) indicated that, milk yield and composition (protein; fat; lactose and ash) improved significantly due to diet supplemented with doum. Keeping the merits of doum into view. Our previous research indicated physiological response of Doum on rabbits (Hassanien et al., 2019). The present study was conducted on the effect of dietary doum supplementation on productive and reproductive performance of does rabbits in Upper Egypt.

Materials and Methods

The present experimental work was carried out at the Experimental Farm of Poultry Production Department, Faculty of Agriculture South Valley University, Qena. This study was undertaken during the spring season of Qena City in the period from April to June 2017. The investigation was carried out under warm conditions having average ambient temperature ranging from 25.8^{0}C (min) to 41.1^{0}C (max), relative humidity 16.3% minimum to 41.5% maximum Table 1 showed maximum, minimum and estimation of average air temperature (C^0) and relative humidity during the experimental period**.**

Temperature-humidity index (THI) was calculated according to Marai *et al*. (2001):

THI = db ºC – [(0.31 – 0.31 × RH) × (db ºC – 14.4)]

Where, db ºC = dry bulb temperature and RH = relative humidity %. The THI values were classified as absence of heat stress (<27.8), moderate heat stress (27.8-28.8), severe heat stress (28.9-29.9) and very severe heat stress (>30.0) (Marai *et al*., 2002).

Table1. Least square means and standard errors of air temperature (AT, ˚C) and relative Humidity (RH, %) in the area of south valley experimental animal farm during the period of study.

MONTH	AIR TEMPERATURE, ^{0}C			RELATIVE HUMIDITY, %			THI
	Minimum	Maximum	Mean	Afternoon	Morning	Mean	
APRIL	15±0.22	32±0.19	23.5±0.37	48.6±0.27	80±1.05	64.3±0.36	22.49
MAY	25.8±0.27	41.1±0.17	33.4±0.27	16.3±0.61	41.5±0.36	28.9±1.10	29.20
JUNE	26±0.29	42±0.18	34± 0.29	17.8±0.63	42.5±0.39	30.15±0.51	29.68

1 .Animals, management and experimental design:

In abstract you mentioned 160 does (80 CAL+80 NEZ) but here you state that 128 doe 64 California (CAL) and 64 Newzland (NEZ) rabbits 6 months old with average initial body weight 3.150±0.05 kg were randomly divided into four groups of 16 does each/breed (CAL and NEZ). Rabbits were individually housed in galvanized wire cages provided with feeders and automatic stainless- steel nipple drinkers where basal diet and water were offered *ad*

libitum. Rabbits were randomly divided into four equal groups. Group 1 served as control (fed basal diet). Groups 2, 3 and 4 fed the basal diet supplemented with 0.3, 0.6 and 0.9g doum /kg diets. respectively, for 12 weeks formulation and chemical composition of the diets was showed in (Table 2).

Table 2. Formulation and chemical composition of the diets (g/kg)

Ingredients %	Control	tested one ration	tested two rations	tested three rations
Alfalfa hay	342	342	342	342
Soybean meal (44% CP)	125	125	125	125
Corn meal	225	225	225	225
Whole sunflower meal	70	69.7	69.4	69.1
Doum (Hyphaenethebaica)	-	0.300	0.600	0.900
Barley meal	140	140	140	140
Wheat bran	50	50	50	50
Beet molasses	12	12	12	12
Calcium carbonate	13.72	13.72	13.72	13.72
Calcium diphosphate	6.71	6.71	6.71	6.71
Sodium chloride	5	5	5	5
Dl-methionine	0.570	0.570	0.570	0.570
Vitamin-mineral premix *	10	10	10	10
Total	1000	1000	1000	1000
Calculated chemical composition of the diets%				
Dry matter	89.2	89.8	89.5	89.5
Crude protein	17.3	17.2	17.00	17.00
Ether extract	5.3	5.2	5.3	5.3
Crude fibre	14.9	14.8	14.8	14.8
Ash	8.8	8.6	8.7	8.7
Digestible energy kcal/kg	2610	2600	2600	2600

*per kg diet: Vit. A 11,000 UI; Vit. D3 2,000 UI; Vit.B1 2.5 g; Vit.B2 4 g; Vit.B6 1.25 g; Vit.B12 0.01 g; Alpha-tocopheryl acetate 50 g; Biotine 0.06 g; Vit. K 2.5 g; Niacine15 g; Folic acid 0.30 g; Dpanthotenic acid 10 g; Choline 600 g; Mn 60 g; Fe 50 g; Zn 15 g; I 0.5 g; Co 0.5 g.

Table 3. Composition and chemical analysis of Doum used in the experiment.

Items	**%**	**Items**	**%**
Protein	6.45	Potassium	5.99
Fat	4.89	Calcium	92.24
Fiber	11.55	Magnesium	1.31
Total carbohydrate	72.89	Iron	1.95
Total Sugars	12.66	Copper	1.82
Reducing Sugars	1.99	Zinc	0.04
Elements(mg/100g)	10.67	Manganese	0.09

Recorded by (Hussein *et al*., 2011).

2. Breeding Data Estimation

The data generated for this study included 128 doe(64 NZW and 64 California) with average initial body weight of 3150±0.05 *kg* and 6 months year .Litter birth and weaning traits investigated included litter size at birth and weaning (No), litter weight at birth and weaning (g), gestation length (days) and preweaning mortality (%).

3. Reproductive Traits

1-Gestation Length (GL): taken in days as the difference between the date of kindling and the date at which successful mating occurred.

2. Litter Size at Birth (LSB): (No) is the number of the doe kindles at the birth.

3. Litter Birth Weight (LBW): (g/litter) is the weight of the kits or kids at birth. Measurement was taken in grams (g), using a digital scale (Mettler Toledo, Top Pan Sensitive Balance, J. Liang Int. Ltd. U.K.

4. Pre-weaning mortality (%): Litter size at birth (alive) – litter size at weaning/ Litter size at birth (alive) x 100.

5-Growth rate of the kits (GR): is increase in body weight and size of the kits from kindling to the weaning period.

Weaning Traits

The weaning traits measured included litter size at weaning (LSW) is actual count of weaners alive at weaning. Litter weight at weaning (LWW) is weight of litters taken in g at weaning.

Does Traits

These traits included No. of inseminated does No. of pregnant does Conception rate (%) which is (No. of pregnant does/ No. of inseminated does)x 100

$$CR = \frac{\text{No of does conceived}}{\text{No of does mated}} \times 100/1$$

Abortion rate (%) calculated as No. of Abortion does/ No. of inseminated does x 100, No. of kindled does, which is actual count of kindled does, kindling rate (%) which is calculated as conception rate - Abortion rate, Or, which is No. of kindled does/ No. of inseminated does x 100, growth rate of kit (g/kit/day) is calculated as bunny weight at weaning (g)-bunny weight at birth (g)/30

Milk yield

Milk samples were taken from nursing does individually within each experimental group, on the 21st day of lactating period (peak of milk production). A part of fresh milk sample was immediately analyzed to estimate milk protein, fat, lactose and ash, by using Milkoscan® analyzer-130 B, N. Foss Electronic-Denmark.

4. Blood Collection and Analysis

Blood samples of about 2ml were taken from two rabbit does in each treatment group. The blood samples were collected at the end of lactation and taken to the laboratory for analysis.To collect the blood sample, a small area from the central ear vein was cleaned with methylated spirit soaked with cotton wool. Blood samples were collected by syringe containing one drop of heparin as anticoagulant (EDTA) to avoid coagulation of the blood samples. The blood samples were later divided into two parts, the first part was used to determine haematological parameters while the second part was centrifuged (15 min, 3500 rpm) and surm removed and stored at frozen of – 20^{o}c. These were later used for oxidative enzyme and hormone analysis. From the samples of the blood collected;

(a) Basic haematology was conducted to check any disease disorder and other related blood disorder such as iron deficiency.

(b) doum content in the blood was determined using oxidative enzyme analysis.

(c) Reproductive hormones vizfollicule stimulating hormone (FSH) and leutinizing hormone (LH) were equally determined.

NB: The Haematogical parameters taken were Hb, PCV, RBC, WBC, N and differential white blood cell, while the oxidative enzyme parameters taken were: doum, MDA, SOD, Glutathione, Glutathione transferase, Glutathione peroxidase, catalase and reduced glutathione.

Methods of Blood Analysis for Various Hematological Parameters

(1) Hemoglobin (HB%)

0.02ml of well mixed whole blood was diluted into four mls of drabkins solution. This is measured spectrophotometrically at 546 nanometer wavelength. After measuring the value of Hb was red from the calibration curve (calorimetrically) according to Van Kampen and Zillestra (1983).

(2) WBC (mm^3) total white blood cell count:

The 0.02ml of blood is diluted with 0.38ml of diluting fluid. The total blood count is counted using improved neubaur counting chamber.

(3) Differential white blood cell count:

Tin blood smear is made on a clean grease free slide allowed to dry and stain with lishman stain. The different white blood are then collected as percentages.

(4) RBCs – Red blood cells count:

All counting methods are based on the dilution of capillary blood or well mixed, correctly anticoagulated venous blood with counting fluids in a special counting pipette. The individual cells are counted in a counting chamber (hemocytometer). Alternatively, electronic counters such as the coulter counter may be used. The coulter counter counts the individual red blood cells of a measured volume of a diluted blood as they pass through a minute orifice guarded by an electric currentflowing between platiunum electrodes. Electronic counters work with a reproducibility of under + 2%. Since the electronic counter enumerates red and white blood cells alike, an error will be introduced if there is a leukocytoissof over 30.000 cells/mm3. In this case, the result may be corrected. With certain adjustments, the coulter counter can bealso used to count platelets with a standard error of + 2.85%. The cell counts are red directly from the counter.

(5) Hematocrit – volume of packed red cells (PCV).

Hemotocrit measure the proportion of red blood cells to surm in a peripheral blood but not in the entire circulation. The hematocrit gives the ratio of total erythrocyte mass to total blood volume. The hematocrit (Ht) reading is recorded as the number of millimeters of packed red cells/100mm blood, indicating the volume (%) of packed red cells/dl blood.

(6)PCV can be measured using Microhemato-crit method:

Here a capillary hematocrit tube approximately 7cm in length and having a bore of about 1.0mm is used. These capillary tubes can be purchased with an anticoagulant already in them to facilitate direct filling from a venous or capillary puncture. Plain tube may be used with blood containing an anticoagulant. Capillary tubes are filled with capillary action, the outside is carefully dried with a piece of gauze, and the opposite end of the tube is sealed. These sealed tubes are then placed in a special high –speed centrifuge with the sealed end near the outside mm of the centrifuge. The tube is centrifuged for 2 minutes at 12.000 rpm, after which the volume of packed cells is read from a scale held against the capillary tube in such a way that the top of the plasma column coincides with the 100% line and the bottom of the packed red cells falls on thezero line.

(7) Hormonal parameters:

FSH (Iu/ml) and LH (iu/ml) The surm concentration of FSH and LH were determined using radioimmunoassay as recommended by (Abraham *et al.* 1971).

Oxidative Enzyme Parameters Measured:

(a) Superoxide Dismutase (SOD)

Superoxide dismutase was assayed according to the method of Misra and Fridovich (1972). 0.1ml of tissue homogenate was added to the tubes containing 0.75ml of ethanol and 0.15ml of chloroform und chilled condition and centrifuged. To 0.5ml of supernatant, 0.5ml of 0.6mM EDTA solution and 0.1ml of 0.1M carbonate biocabonate buffer (PH 10.2) were added. The reaction was initiated by the addition of 0.5ml of 1.8mM epinephrine and the increase in absorbance at 30 second interval for 3 minutes was measured at 480nm in a Shimadzu UV spectrophotometer. One unit of superoxide dismutase activity is the amount of protein required for 50% of inhibition of epinephrine antoxidation minute.

(b) Assay of catalase

Catalase was assayed according to the method of (Takahara *et al* 1960). To 1.2ml of 0.01nm phosphate buffer (pH 7.0), 0.5ml of tissue homogenate was added. The enzyme reaction was started by the addition of 1.0ml of 0.2mM hydrogen peroxide solution. The decrease in absorbance was measured at 240nm for every 30 seconds up to 3 minutes. The enzyme blank was run simultaneously with 1.0ml of distilled water instead of hydrogen peroxide. The enzyme activity was expressed as µmoles of hydrogen peroxide decomposed/minute/mg of protein.

(c) Assay of Glutathione peroxidase (GPx)

The activity of glutathione peroxidase was assayed by the method of Rotruck et al. (1973). The reaction mixture consisting of 0.2ml of 0.8nM EDTA, 0.1ml of 10nm sodium azide, 0.1ml of 2.5nM H202, 0.2ml of GSH,0.4ml of 0.4nM phosphate buffer (pH 7.0) and 0.2ml of homogenate was incubated at 37oc for 10 minutes. The reaction was arrested by the addition of 0.5ml of 100% TCA and the tubes were centrifuged at 3500 rpm. To the supernatant, 3.0ml of 0.3M disodium hydrogen phosphate and 1.0ml of DTNB were added and the color developed was read at 420nm immediately. The activity of GPx was expressed as µmoles of glutathione oxidized/minute/mg of protein.

(d) Assay of Glutathione – S – transferase (GST)

Glutathione – S – transferase was assayed by method of Habig *et al.* (1974). The reaction mixture containing 1.0ml of 0.3nM phosphate buffer (pH 6.5), 0.1ml of 30Nm CDNB and 0.1ml of tissue homogenate was made up to 2.5ml with water. The reaction mixture was pre – incubated at 37oc for 5 minutes. 0.1ml of 30nM GSH was added and the change in 0.D was measured at 340nm for 3minutes at 30 seconds interval. Activity of glutathione – S – transferase was expressed as nmoles of CDNB conjugate formed/minute/mg of protein.

(e) Estimation of total reduced glutathione

Total reduced glutathione was determined by the method of (Sedlak and Lindsay 1968) modified according to the method of (Moron *et al*., 1979). 0.1ml of the test sample was precipitated with 5% TCA. The precipitate was removed by centrifugation. To 2.0ml of the supernatant, added 2.0ml of 0.6mg of DTNB in 0.2M phosphate buffer (pH 6.5). The absorbance was read at 412nm against a blank containing TCA instead of sample. A series of standards treated in a similar manner were also run to determine the glutathione content. The amount of glutathione was expressed as mg/dl for surm and mg/100g of tissues.

(f) Assay of Lipid Peroxidation (LPO) – MDA

Malondialdehyde contents were estimated according the method of Buge and (Aust 1978). To 1.0ml of the sample, 2.0ml of TCA – TBA – HCI reagent was added and mixed thoroughly. The solution was heated for 15minutes in a boiling water bath. After cooling, the flocculent precipitate was removed by centrifugation at 1000g for 10minutes. The absorbance was determined at 535nm against a blank that contains all the reagents except the sample. The results were expressed as nmoles of MDA formed/minute/mg protein using an extinction coefficient of the chromophore 1.56 x 105Mcm and expressed as moles of MDA formed/minute/mg protein.

(g) Glutathione Determination

This was based on the method of (Jollow *et al.* 1974). Reduced glutathione (GSH) forms the buck of non-protein sulfhydryl groups. This method is based on the formation of relatively stable yellow colour when Ellman's reagent is added to a sulfhydryl compound.2-nitro-5-thiobenzoic acid, the chromophoric product resulting from the reaction of Ellman's reagent with reduced glutathione absorbs at 412nm. The absorbance at 412nm is therefore proportional to glutathione content.

(h) Doum

Pipette 0.1ml of the sample. Add 0.9g of distilled H20. Add 5ml of concentrated hydrogen chloride. Then shake the mixture. Add 2ml of 2, 4, DNPH-NEDA reagent. Stands for 10 minutes with occasional shaking. Dilute to 10ml with distilled water.Measure the absorbance at 520nm.

Statistical Analysis

The data were analyzed using General linear method of statistical analysis system(SAS 2004) Duncan Multiple range Test was used to compare the differences among means (Duncan, 1955**)**. Data presented as percentages were transformed to the corresponding arcsine values (Warren and Gregory, 2005) before being statistically analyzed

$Yijk=\mu+ Di + Bj +DBij +Eijk$

Where: Yijk = any observation of the rabbit in the treatment; μ = Overall mean, common element to all observations; Di = Effect of the treatments(doum levels) (i = 1, 2, 3 and 4); Bj= Effect of the breeds(j=1 and 2NZW and CAL); αbij=The interaction between two factor; Eijk= Random error component assumed to be normally distribute.

Results and Discussion

1. Temperature-humidity index (THI):

The estimated THI values (Table 1) indicated that during the experimental period (from April to, June 2017) rabbit bucks were exposed to severe heat stress (Maximum THI= 29.68) according to Marai *et al*. (2002).

2. Reproductive Performance

Data presented in Table 4 showed that, NEZ and CAL rabbits does fed diets supplemented with 0.9, 0.6 and 0.3 g doum/kg diet using bucks treated with the same treatment, recorded conception and kindling rates; litter size and weight and bunny weight at birth and at weaning were significantly ($p\leq0.05$) better, and in descending order, than of those recorded by does fed un-supplemented diet. Also, it can be noticed that doum treatments showed decrease in abortion and mortality rate when compared with control group. Growth rate of kit (g/kit/wk) was significantly increased as compared to control group. Mortality was decreased significantly ($p < 0.05$) in treated groups compared to control. California does showed recorded significant higher conception rate, kindling rate, litter size at birth and at weaning and lower mortality rate compared to the NEZ breed. These results are in agreement with **(**Hassanien et al., 2019; Fawaz et al., 2019a, b; Abdel-Wareth et al., 2019a, b;

Bozkurt et al., 2014; Hippenstiel et al., 2011). Zeidan *et.,al* (2001) Similarly, Kindling rate, Litter size at birth and at weaning in CAL were significantly better than NZW rabbits .The study showed that the different levels of doum fed to rabbit does had nosignificant effect (P>0.05) on body weight at mating, kindling and weaning. Rommers *et al.* (2001) and Szendro *et al.*(2002) stated that improvement in litter traits proved that, doum treatments are capable to improve the milking ability of the rabbit does which is reflected in her ability to suckle her young till weaning, and significant decrease in mortality compared with the control. The milk available per kit may also have a pronounced effect on the mortality of young rabbits. Besides that, the increase milk production may be due to increase in litter size at birth, where there was a positive correlation between the litter size at birth and milk yield (Lebas *et al.*, 1997; and Rommers *et al.*, 2001).(Mervet Ghazal *et.,al* 2016) showed that, Hy-Plus rabbit does fed diets supplemented with 750, 500 and 250 g doum using bucks treated with the same treatment, recorded conception and kindling rates; litter size and weight and bunny weight at birth and at weaning significantly ($p \leq 0.05$ or 0.01) better, and in descending order, than of those recorded by does fed un-supplemented diet.

Milk yield and Milk composition

The effect of doum supplementation on Milk yield and Milk composition of rabbit does is presented in Table(5-6).milk yield and composition (protein; fat; lactose and ash) were significantly ($p \leq 0.05$) better than control group. Does fed diet of 0.90 g doum/kg diet had significantly ($p<0.05$) higher milk yield and California breed showed significantly higher milk yield and improved milk composition as compared to Newzland breed. Similar results of milk yield and milk composition were observed by Mervat *et.,al.* (2016).

Haematology, FSH and LH Characteristics

The effect of doum supplementation on haematology, FSH, and LH of rabbitdoes is presented in Table 7. below. Does fed on diet supplemented with 0.90 gdoumpresented significantly($p<0.05$) greater haemoglobin (HB) concentration, RBC, N, E, and FSH than those fed on 0.30g and 0.60gdoum. (Write full rather than abbreviations). You described the results of other authors . Give references in line with your study and in contrast.

Oxidative Enzymes Characteristics

Results showed that does fed diet with 0.9 gdoum had significant decrease ($p<0.05$) in MDA compared to other treatment groups, while significant increase ($p<0.05$) in SOD concentration than thosefed 0.3 and 0.60 g. Does fed diet supplemented with 0.30 and 0.60g depicted greater influenceon glutathione transferasethan those of 0.90 and control group.However, doum supplementation of diet showed no significant ($p>0.05$) results on catalase, gluthathione and glutathione (Table 8).This results agreement with(Al-Masri, 2012) who reported thatdoum powder supplements showed a significant increase in the values of liver SOD,GPX, GST and catalase and a significant decrease in MDA at $p <0.01$&0.001 when compared with control group

Table 4. Reproductive performance of rabbit does as affected by feeding diets supplemented with doum (*Hyphaenethebaica).*

Reproductive parameter	Doum levels (g/kg)				Species		SEM	P – value		
	T0_(0g)	T1_(0.3g)	T2_(0.6g)	T3_(0.9g)	NZW	CAL		D	S	D × S
Doe body weight atmating(g)	3150	3155	3158	3155	3158	3155	0.06	0.97 ^{NS}	0.89	0.91
No. of pregnant does	18^{d}	22^{c}	24^{b}	26^{a}	24^{b}	$26.^{a}$	0.48	0.0001	0.0001	0.0001
Conception rate (%)	56.25^{d}	68.75^{c}	75.00^{b}	81.25^{a}	75.00^{b}	81.25^{a}	1.5	0.0001	0.0001	0.0001
Abortion rate (%)	6.25^{a}	3.12^{b}	0.00^{d}	0.00^{d}	9.37^{a}	6.25^{b}	0.52	0.0001	0.0001	0.0001
No. of kindled does	16	21	24	26	21	24	0.54	0.61	0.5	0.0001
Kindling rate (%)	50^{d}	65.63^{c}	75^{b}	81.25^{a}	65.63^{b}	75^{a}	1. 9	0.00	0.0001	0.0001
Litter size at birth (No)	5.8^{c}	6.8^{b}	8^{a}	8.9^{a}	8^{b}	8.9^{a}	0.13	0.00	0.05	0.8186
Litter body weight at birth (g)	261	312^{c}	390^{b}	445^{a}	368^{b}	445.9^{a}	0.215	0.0001	0.0001	0.3892
Doe body weight at kindling(g)	3430	3455	3449	3460	3465	3460	0.08	0.86^{NS}	0.62	0.815
Bunny weight at birth(g/kit)	45.0^{bc}	46.0^{b}	48.8^{ab}	50^{a}	46^{b}	50.1^{a}	0.73	0.05	0.05	0.0080
Litter size at weaning (No)	5^{c}	6^{b}	7.7^{a}	8.6^{a}	5^{b}	8^{a}	0.19	0.0001	0.0001	0.4596
Bunny weight at weaning (g)	670^{c}	733^{b}	790^{ab}	820^{a}	636.75^{b}	676.31^{a}	7.02	0.05	0.05	0.9477
litter weight at weaning (g)	3350^{d}	4398^{c}	6083^{b}	7052^{a}	3183.75^{b}	5545.7^{a}	78.09	0.0001	0.00	0.3438
Growth rate of kit (g/kit/day)	20.8^{d}	22.9^{c}	24.7^{b}	25.6^{a}	19.69	20.8	0.21	0.0001	0.00	0.9552
Pre weaningMortality rate (%)	13.8^{a}	11.8^{b}	3.75^{c}	3.4^{c}	37.5^{a}	10.11^{b}	0.34	0.0001	0.0001	0.0001
Doe body weight atweaning(g)	3200	3210	3155	3158	3210	3200	14.12	0.91 ^{NS}	0.84	0.092

Means bearing different letter superscripts (a, b, c, d) within the same row are significantly ($p \leq 0.05$) different No. of inseminated does=32

Conception rate (%)=No. of pregnant does ÷ No. of inseminated does X 100.

Mortality rate was calculated individually according to the following equation:

Litter size at birth-Litter size at weaning / Litter size at birth X 100

The weaning = 30 day

Table 5: Milk yield (g) of rabbit does fed diets with different levels of doum (*Hyphaenethebaica)*

Period (Days)		Doum levels (g/kg)				Species		SEM	P-value		
From	To	T0 (0g)	T1 (0.3g)	T2 (0.6g)	T3 (0.9g)	NZW	CAL		D	S	D × S
Birth	7	416.5^{d}	497.00^{c}	523.6^{b}	532.42^{a}	485.38^{b}	495.95^{a}	0.84	0.0001	0.0004	0.7654
8	14	623.58^{c}	700.5^{b}	738^{a}	742.8^{a}	697.56^{a}	705.00^{a}	1.16	0.0001	0.3208	0.9566
15	21	882.36^{d}	970.86^{c}	1048.8^{b}	1059.7^{a}	985.5^{b}	995.40^{a}	1.52	0.0001	0.0051	0.7375
22	30	926.96^{c}	1016.4^{b}	1207.2^{a}	1220.0^{a}	1089.4^{b}	1093.6^{a}	2.02	0.0001	0.5907	0.5643
Total milk yield (g)		2849.4^{d}	3184.7^{c}	3157.6^{b}	3554.9^{a}	3257.8^{b}	3289.9^{a}	5.2	0.0001	0.0001	0.7273

Table 6 :Milk composition of NZW and CAL rabbit does fed diets with different levels of Doum (*Hyphaenethebaica*).

Milk composition	Doum levels (g/kg)				Species		SEM	P- value		
	control (0g)	T1 (0.3g)	T2 (0.6g)	T3 (0.9g)	NZW	CAL		D	S	D × S
Milk Protein (%)	11.04^{d}	11.33^{c}	12.28^{b}	12.53^{a}	11.76^{b}	11.83^{a}	0.11	0.0001	0.022	0.2934
Milk ash (%)	3.65^{d}	3.82^{c}	4.04^{b}	4.13^{a}	3.91^{a}	3.91^{a}	0.15	0.0001	0.874	0.8973
Milkfat(%)	16.11^{d}	17.87^{c}	17.84^{b}	18.33^{a}	17.47^{a}	17.49^{a}	0.05	0.0001	0.286	0.6256
Milk lactose (%)	3.77^{d}	3.96^{c}	4.35^{b}	4.57^{a}	4.18^{a}	4.16^{a}	0.03	0.0001	0.622	0.0119

Table 7. Effect of doum supplementation in diet of rabbit does on haematology, fsh and lh characteristics.

Reproductive Parameter	Doumlevels (g/kg)				Species		SEM	P-value		
	T0 (0g)	T1 (0.3g)	T2 (0.6g)	T3 (0.9g)	NZW	CAL		D	S	D × S
HBg/dl	11.85^{b}	12.10^{ab}	12.70^{ab}	13.5^{a}	12.78	12.80	0.35	0.05	0. 18	0.05
PCV (%)	35.67^{b}	35.50^{b}	34.67^{b}	44.62^{a}	35.50^{b}	38.74^{a}	1.20	0.04	0.2876	0.74
RBC (x10^{6})	4.77^{b}	5.59^{ab}	8.86^{a}	8.86^{a}	8.86^{a}	8.86^{a}	0.16	0.05	0.85	0.8774
N(µL)	14200^{b}	13600^{b}	13400^{b}	22300^{a}	13400^{b}	13600^{b}	1.84	0.00	0.021	0.31
E (%)	19.5^{b}	21.00^{ab}	26.50^{a}	24.31^{a}	26.50^{a}	24.31^{a}	1.70	0.04	0.022	0.29
FSH(LU/ml)	2.90^{c}	2.85^{c}	8.45^{b}	15.43^{a}	8.45^{b}	13.43^{a}	1.15	0.00	0.05	0.31
LH (LU/ml)	0.02	0.08	0.09	0.12	0.09	0.08	0.02	0.29^{NS}	0.0419	0.22

a,b,c: Means in a row with different superscripts are statistically significant (P<0.05)

NS = Not significant

Table 8. Effect of doum supplementation on oxidative enzymes characteristics of rabbit does

Parameters(Oxidatie Enzymes)	Doumlevels (g/kg)				Species		SEM	P-value		
	T0 (0g)	T1 (0.3g)	T2 (0.6g)	T3(0.9 g)	NZW	CAL		D	S	D × S
Doum(g/dl)	0.00	0.58	0.60	0.63	0.57	0.58	0.14	0.5^{NS}	0.5	0.6
MDA (g/dl)	3.18^{a}	2.84^{ab}	2.09^{bc}	1.97^{c}	3.09	3.18	0.17	0.014	0.017	0.019
Catalase (U/l)	1.34	1.28	1.34	1.24	1.28	1.34	0.02	0.19^{NS}	0.17	0.18
SOD (NL)	66.45^{a}	56.21^{b}	54.66^{b}	64.34^{a}	66.45^{a}	64.34^{a}	1.42	0.01	0.03	0.04
Glutathione transferase(HI)	1.16^{ab}	1.22^{a}	1.21^{a}	1.11^{b}	1.21^{a}	1.22^{a}	0.01	0.05	0.87	0.89
Glutathione Peroxide (µL)	232.06^{a}	230.00^{b}	257.14^{ab}	228.06^{b}	230.0^{b}	228.06^{b}	9.7	0.05	0.89	0.877
Glutathione (Hg/ml)	0.18^{a}	0.13^{c}	0.14^{b}	0.14^{bc}	0.14^{b}	0.14^{b}	0.01	2.91^{NS}	0.59	0.56
Reduced glutathione (µmol/L)	0.07	0.07	0.06	0.06	0.06	0.06	0.00	0.43^{NS}	0.073	0.53

a,b,c: Row means with different superscripts are statistically significant (* P<0.05)
NS = Not significant

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