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Reproductive Performance And Physiological Response Of Rabbit Does As Affected By Supplementation Rosella (*Hibiscus Sabdariffa*) And Anise Seeds (*Pimpinella Anisum* L.)

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ABSTRACT

This study examined the impact of supplementing natural feed with rosella flowers and anise seeds on certain physiological and reproductive traits in New Zealand White rabbits does. Thirty New Zealand White (NZW) does, aged 6-8 months and weighing an average of 2.984 ± 125.76 kg, were randomly assigned to six experimental groups, each consisting of five rabbits. Anise seeds and rosella flowers were incorporated into the control diet at levels of 0.05% (0.5 g/kg) and 0.1% (1 g/kg), respectively.

***The present results showed that** body weight changes during gestation and the suckling period significantly(P<0.05) increased with the supplementation of 0.05% rosella flowers. The inclusion of 0.05% and 0.1% rosella flowers, as well as 0.05% anise seeds and a combination of 0.05% rosella flowers with 0.05% anise seeds in the diets of the does, significantly enhanced conception rates, litter size, litter weight, litter weight (g/head) , and litter weight gain from birth to weaning, leading to a significant (P <0.05) reduction in mortality rates (%). Additionally, milk yield and the chemical composition of fat and lactose were significantly (P <0.05) boosted by the supplementation of rosella flowers, anise seeds at the 0.05% level, and the combination of 0.05% rosella flowers with 0.05% anise seeds when compared to the control group.*

The data indicated that the supplementation of anise seeds and rosella flower led to a substantial increase in total antioxidant capacity, superoxide dismutase activity, and glutathione reductase levels, as well as in the concentrations of immunoglobulin IgA, IgG, and IgM. Conversely, there was a notable decrease in thiobarbituric acid reactive substances.

Conclusively, *the findings of the current study suggest that incorporating dietary supplements of rosella flower and anise seeds at a concentration of 0.05% each, as well as a combination of 0.05% rosella flower and 0.05% anise seeds, into rabbit diets enhances their reproductive and physiological traits.*

Keywords: medicinal plants, rabbits reproduction,, physiological. performance

INTRODUCTION

Numerous researchers have focused on the reproduction of female rabbits, as this knowledge is crucial for successful rabbit breeding. Key economic traits in productive animals include litter size, birth weight, and conception rate. To maximize these benefits, it is essential to concentrate on these characteristics and consider the factors that directly influence them during the breeding of any productive species (Mahmoud, 2013). Additionally, utilizing natural materials such as herbs can enhance feed intake, stimulate endogenous secretion, and may possess antibacterial and anticoccidial properties. According to Abdulmanan *et al.* (2012), incorporating fenugreek and anise seeds into rabbit diets has been shown to improve litter size at birth (El-Hammady and Abdel-Kareem, 2015). Anise is rich in essential fatty acids, with anethol being its primary active component, and it has been demonstrated to inhibit bacterial (Sagdic and Ozcan, 2003) and fungal (Soliman and Badea, 2002) growth while also promoting the secretion of digestive enzymes and enhancing appetite (Seleem, 2008).

Roselle (*Hibiscus sabdariffa*), a versatile edible plant, boasts a range of applications in food products, while its flowers and calyces possess antiseptic, diuretic, antioxidant, and antimutagenic properties (Salleh *et al*., 2002). Rich in vitamins, minerals, and bioactive compounds like organic acids, phytosterols, and polyphenols, roselle is a valuable source of antioxidants. Beyond its culinary uses, roselle (*Hibiscus sabdariffa*) is also recognized for its medicinal properties, including antiseptic, diuretic, antioxidant, and antimutagenic effects. Its flowers and calyces are particularly notable for their nutrient profile, which includes vitamins, minerals, and bioactive compounds such as organic acids, phytosterols, and polyphenols (Salleh *et al*., 2002).

Therefore, the objective of this study was to explore the impact of incorporating rosella flowers and anise seeds as natural feed supplements on certain reproductive traits and economic efficiency of New Zealand White rabbit does.

MATERIALS AND METHODS

The experimental work of this study carried out at Poultry Research Station, in Nubaria, Research Station located in Alexandria governorate, Egypt, rosella flower (Hibiscus Sabdariffa*)* and anise seeds *(Pimpinella Anisum* L.*)* were purchased from Egyptian herbal market. Thirty New Zealand White (NZW) rabbit does of age five months were randomly divided into six experimental groups, the first group was fed control diet while, the other groups were fed control diets supplemented with 0.05% (0.5g/kg diet) and 0.1% (1g/kg diet) % rosella flower (*Hibiscus Sabdariffa*), 0.05(0.5gm/kg) and 0.1 % (1g /kg diet) anise seeds *(Pimpinella Anisum L.*) and mixture of 0.05% (0.5g/kg diet) rosella plus 0.1%%(1g /kg diet)) anise seeds(w/w), respectively.

The basal diet was formulated to contain adequate levels of nutrients for New Zealand White (NZW) rabbit doe. The ingredients of diets formulation and its chemical composition are presented in Table 1. All the experimental diets were formulated according to National Research Council (NRC, 1994). Chemical analysis of ingredients and diets were determined according to (AOAC, 2000). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and detergent lignin (ADL) were determined by method of Van Socest (1991).

Management

Thirty New Zealand White (NZW) does aged 6-8 months weighing 2.984 ± 125.76 kg were housed separately in individual wired-cages. (45 x 45 x 38). Mating was achieved by 5 adult NZW bucks aged 6 months with good fertility records. Bucks were fed on control diet. All rabbits were kept under the same managerial and hygienic conditions and housed in metal battery cages supplied with separated feeders. Diets were offered *ad-libitum* and fresh water was available all times from automatic nipple drinkers. Amount of feed consumed was calculated weekly.

Reproductive performance

For does, the change in live body weight during gestation period was calculated as the difference between the live body weight at kindling and body weight post-partum, while the change in live body weight during suckling was calculated as the difference between the live body weight at the end of suckling period (at weaning) and the body weight post-partum. Conception rate was tested at 14 or 15 days post mating by abdominal palpation. Females with a negative palpation were mated the same day recording again sexual receptivity parameters. Litter size and weight of each pregnant doe was recorded at parturition. Results from the first and second presentation to a buck were pooled. Percentage

Table 1. Ingredients and chemical composition of experimental diets.

Ingredients	Treatments groups					
	Control	Rosella flower 0.05	Rosella flower 0.10	Anise seeds 0.05	Anise seeds 0.1	0.05 Rosella flower +0.05Anise seeds
Berseem hay	31.60	31.60	31.60	31.60	31.60	31.60
Barley grain	17.8	17.80	17.80	17.80	17.80	17.80
Yellow corn	8.30	8.30	8.30	8.30	8.30	8.30
Corn gluten meal	5.00	5.00	5.00	5.00	5.00	5.00
Wheat bran	15.90	15.90	15.90	15.90	15.90	15.90
Soybean meal	14.40	14.40	14.40	14.40	14.40	14.40
Molasses	3.60	3.60	3.60	3.60	3.60	3.60
Di Ca phosphate	1.40	1.40	1.40	1.40	1.40	1.40
Limestone	1.10	1.10	1.10	1.10	1.10	1.10
Salt	0.50	0.50	0.50	0.50	0.50	0.50
premix	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100
Calculated analysis						
DM	90.87	90.87	90.87	90.87	90.87	90.87
OM	93.56	93.56	93.56	93.56	93.56	93.56
CP	17.96	17.96	17.96	17.96	17.96	17.96
CF	12.17	12.17	12.17	12.17	12.17	12.17
EE	3.57	3.57	3.57	3.57	3.57	3.57
NFE	59.86	59.86	59.86	59.86	59.86	59.86
Ash	6.44	6.44	6.44	6.44	6.44	6.44
NDF	34.63	34.63	34.63	34.63	34.63	34.63
ADL	20.33	20.33	20.33	20.33	20.33	20.33
DE(kcal/kg	4.390	4.390	4.390	4.390	4.390	4.390

Each kg of premix contained 100 mg vitamin E, 10 mg vitamin B1, 20 mg, vitamin B2, 400,000 IU vitamin A, 100,000 IU vitamin D, 30 g Calcium, 12 g Phosphorus, 40 g Na, 1000 mg Cu, 60 mg I, 60 mg Co, 11 g Mg, 2000 mg Manganese, 2000 mg Zn, 3000 mg Fe.

occurrences of the receptivity parameters were compared within and between each treatment group by chi square analysis. The overall conception rate (or fertility)

considered as a variable of Bernoulli (trait 0-1) was analyzed by analysis of variance (and Duncan test) taking into account the fixed effect of the treatment. Suckling kids were allowed to eat the same diet as their mother and were weaned at 35days of age. Rabbit does were separated from their kids after parturition and controlled suckling was applied to measure milk production To prevent free nursing, does were placed in cages next to the nest box. Litter sizes (LS) of kits were kept constant throughout lactation chemically analyzed for fat, protein, lactose, by a milk analyzer (Milko tester Insturment Inc. Bulgaria).

Milk production was estimated daily from weight loss of rabbit does after suckling (Mohamed *et al*., 2016). Milk production was assessed at 7^{th}, 14^{th}, 21^{st} and 28^{th} day of lactation. Kids were separated from collection samples in the morning. Litter weight was measured at birth and at weaning. Mortality rate (MR) during lactation for kids was calculated as:

$$\text{MR of kids} = \frac{\text{Number of the kids born alive - Number of the kids at weaning}}{\text{Number of the kids born alive}} X\ 100$$

Blood measurement

Individual blood samples were taken at the first and second abdomen after birth at 9.00 am from the marginal ear vein and collected in 5 ml. heparinized test tubes and centrifuged measured at 3000 r.p.m for 20 minutes then plasma were transferred and stored in deep freezer at approximately -20ºC till the time to determine. The quantitative immunological determination of immunoglobulin G, immunoglobulin A and immunoglobulin M in plasma on COBAS INTEGRA by Roche Diagnostics GmbH, SandhoferStrasse116, D-68305 Mannheim, USA.

Economic efficiency

The economic efficiency of experimental diets was calculated as the ratio between net revenue and cost of feed consumed according to Soliman *et al*., (2012).

Statistical analysis

Data from all response variables were analyzed using General Linear Models (GLM) procedure of SAS Institute (2003). The statistical model used was as follows:

$$Yij = \mu + Ti + eij$$

Where: μ= Overall mean of Yij,, Ti = Effect of treatment, i = (1,…,5), eij = Experimental random error. Variables having a significant F-test were compared using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of dietary treatments on performance of rabbit does

Data in Table 2 showed no significant differences in doe weight, weight at breeding, pregnancy weight, suckling doe weight, and daily feed intake among various treatment groups. However, notable changes were observed in doe body weight. Specifically, those fed 0.05% rosella during gestation exhibited the highest weight gain, at +185.5g compared to other groups. In contrast, does fed control and 0.1% rosella experienced significant weight increases, with gains of -152.67g and -121.11g, respectively. Notably, does fed 0.1% anise seeds showed the lowest weight change, with a decrease of -92.85g. The results also showed improved conception rates in rabbits fed diets containing 0.05% rosella flower and a combination of 0.05% rosella flower and 0.05% anise seeds, relative to those fed the control diet. In this context, El-Hammady and AbdelKareem (2015) concluded that number of mating per conception and conception rate in rabbits fed diet supplemented fenugreek seeds was significantly improved compared to those received the control diet. Also, Eiben *et al*. (2004) found that supplemented with 6 g fenugreek + 6 g anise seed/kg diet litter size at 17 days of age tended to be smaller in rabbit does fed diet than that in the control does. Sallam *et al*. (2019) found that that the best insignificant the number of services per conception, does feed intake during pregnancy and suckling periods was not significant for using dietary fenugreek and anise seeds.

The productive traits of the offspring, influenced by various experimental treatments, are displayed in Table (3). Supplementation with 0.05% and 0.1% rosella flower, 0.05% anise seeds, and 0.05% rosella flower combined with 0.05% anise seeds in the diets of does significantly ($P<0.05$) enhanced litter size, litter weight, litter weight (g/ head), and weight gain from birth to weaning, compared to the control group and the 0.1% anise group. However, the increases observed with 0.05% and 0.1% rosella flower were not statistically significant compared to the control. Additionally, while litter size, litter weight, litter weight per head (g/h), and weight gain from birth to weaning were not significantly impacted by the 0.1% anise seed supplementation, a decrease in weight gain was noted with the 0.05% anise seed addition at 7, 14, and 21 days and at weaning, when compared to the control group. Similarly, litter weight per head (g/h) decreased non-significantly with the 0.05% rosella flower at 7 days and the 0.1% rosella flower at both 7 days and weaning. Conversely, litter size and weight from day 7 to weaning, as well as weight per treatment at 7 days, were significantly ($p<0.05$) (plower, apart from a

Table 2. Effect of rosella flower (*Hibiscus Sabdariffa)* and anise seeds *(Pimpinella Anisum* L*)* supplementation on performance of rabbit does.

Items	Treatments groups					
	Control	Rosella flower 0.05	Rosella flower 0.10	Anise seeds 0.05	Anise seeds 0.1	Rosella flower +Anise seeds
Performance of rabbit does						
Does weight at mating	2998.65	2958.00	3010.50	2995.50	2981.00	2965.50
Does weight at Pregnant	3168.57	3141.50	3198.33	3145.00	3115.00	3117.50
Change in body weight (g)	144.78 [b]	183.50 [a]	158.88 [b]	150.00 [b]	125.00 [c]	152.00 [b]
Does weight at suckling	2871.42	2849.50	2918.33	2901.66	2897.14	2851.00
Change in body weight (g)	-152.35 [c]	-108.50 [b]	-121.11 [b]	-93.33 [a]	-92.85 [a]	-114.50 [b]
Conception rate, %	70 [c]	100 [a]	90 [b]	90 [b]	70 [c]	100 [a]
Feed intake (g/d)						
Pregnant does	217.47	207.50	207.77	206.11	200.00	211.00
Lactating does	269.56	268.95	268.86	267.22	241.42	250.00

a, b and c Means in the same row with different superscripts are significantly different ($P<0.05$). SEM: Standard error of the mean.

significant increase in litter size at 14 days with the 0.1% anise supplementation compared to the control. The mortality rate significantly ($P<0.05$)) decreased with the supplementation of either rosella flower or anise seeds at 0.05%, as well as with the combination of 0.05% rosella flower and 0.05% anise seeds when compared to the other groups. However, the mortality rate showed a non-significant reduction in does given 0.1% rosella flower or anise seeds compared to the control group. In this context, Eiben *et al.* (2006) found that incorporating anise or fenugreek seeds into rabbit diets significantly ($P <0.05$) enhanced litter weight at weaning.

Additionally, El-Hammady and Abdel-Kareem (2015) reported that supplementing Bouscat rabbit does with a combination of herbana capsules and dried herbal seed pellets (comprised of 50% fenugreek, 30% caraway, 10% fennel, and 10% dill) resulted in no significant reduction in mortality rates.

Table 3. Effect of rosella flower (*Hibiscus Sabdariffa)* and anise Seeds *(Pimpinella Anisum* L*) s*upplementation on litter performance and mortality rate.

Items	Treatments groups					
	Control	Rosella flower 0.05	Rosella flower 0.10	Anise seeds 0.05	Anise seeds 0.1	Rosella flower +Anise seeds
Litter size (n/Litter) and mortality rate						
At Birth	5.85 ^{c}	7.00 ^{a}	7.00 ^{a}	6.89 ^{b}	6.42 ^{b}	7.10 ^{a}
At 7 days	4.85 ^{c}	6.00 ^{a}	6.11 ^{a}	6.00 ^{a}	5.71 ^{b}	6.20 ^{a}
At 14 days	4.14 ^{b}	5.50 ^{a}	5.55 ^{a}	5.56 ^{a}	5.00 ^{a}	5.60 ^{a}
At 21 days	4.14 ^{c}	5.50 ^{a}	5.11 ^{a}	5. 44 ^{a}	4.71 ^{b}	5.50 ^{a}
At 28 days	4.14 ^{c}	5.50 ^{a}	5.11 ^{a}	5. 44 ^{a}	4.71 ^{b}	5.50 ^{a}
Weaning	4.14 ^{c}	5.50 ^{a}	5.11 ^{a}	5. 44 ^{a}	4.71 ^{b}	5.50 ^{a}
Litter weight (g/treatment)						
At Birth	301.46 ^{b}	464.30 ^{a}	458.55 ^{a}	452.22 ^{a}	335.71 ^{b}	440.00 ^{a}
At 7 days	425.85 ^{c}	529.30 ^{b}	528.88 ^{b}	566.66 ^{b}	484.28 ^{c}	658.50 ^{a}
At 14 days	590.71 ^{d}	921.10 ^{a}	855.00 ^{b}	880.55 ^{b}	714.28 ^{c}	971.00 ^{a}
At 21 days	891.71 ^{d}	1417.5 ^{a}	1269.44 ^{b}	1368.88 ^{ab}	1026.42 ^{c}	1516.50 ^{a}
At 28 days	1382.28 ^{c}	2118.40 ^{a}	1878.33 ^{b}	2020.55 ^{a}	1504.28 ^{c}	2051.00 ^{a}
Weaning	1549.57 ^{e}	2308.5 0 ^{a}	2001.60 ^{b}	2261.11 ^{a}	1710.71 ^{d}	2284.00 ^{a}
Litter weight (g/head)						
At Birth	50.65 ^{c}	66.48 ^{a}	65.63 ^{a}	65.81 ^{a}	52.24 ^{c}	61.98 ^{a}
At 7 days	88.11 ^{c}	88.16 ^{c}	86.85 ^{c}	94.44 ^{b}	84.94 ^{c}	105.84 ^{a}
At 14 days	142.50 ^{c}	167.75 ^{a}	153.77 ^{b}	158.79 ^{b}	142.85 ^{c}	173.36 ^{a}
At 21 days	215.35 ^{c}	257.60 ^{b}	248.27 ^{b}	251.37 ^{b}	219.14 ^{c}	276.55 ^{a}
At 28 days	334.47 ^{b}	385.68 ^{a}	367.98 ^{a}	371.37 ^{a}	319.89 ^{b}	372.98 ^{a}
Weaning	374.42 ^{b}	419.50 ^{a}	391.68 ^{ab}	415.51 ^{a}	362.75 ^{b}	415.15 ^{a}
Litter weight gain (g)						
At 7 days	17.77 ^{b}	9.28 ^{c}	10.04 ^{c}	16.34 ^{b}	21.22 ^{b}	31.21 ^{a}
At 14 days	23.55 ^{d}	55.97 ^{a}	46.58 ^{b}	44.84 ^{b}	32.85 ^{c}	44.64 ^{b}
At 21 days	43.00 ^{d}	70.91 ^{b}	59.21 ^{c}	69.76 ^{b}	44.59 ^{d}	77.92 ^{a}
At 28 days	70.08 ^{b}	100.12 ^{a}	86.98 ^{ab}	93.09 ^{a}	68.26 ^{b}	76.35 ^{b}
Weaning	51.04 ^{a}	35.41 ^{b}	22.77 ^{c}	41.51 ^{b}	35.35 ^{b}	50.96 ^{a}
Mortality rate%	29.11 ^{a}	21.19 ^{b}	26.58 ^{a}	20.37 ^{b}	26.11 ^{a}	22.38 ^{b}

a, b and c Means in the same row with different superscripts are significantly different ($P<0.05$). SEM: Standard error of the mean.

Conversely, Badawi *et al*. (2016) demonstrated that diets supplemented with 1.5% marjoram resulted in significantly ($P \leq 0.05$) larger litter sizes and weights at 7, 14, 21, and 28 days of age (the weaning age). Sallam *et al*. (2019) reported that adding 3% or 6% fenugreek and anise seeds to rabbit doe diets had no significant impact on litter size, litter weight at birth, or pre-weaning mortality. However, a mixture of 3% fenugreek and 3% anise seeds in the does' diets was linked to increased litter size at weaning, as well as significantly ($p<0.05$) improved conception and parturition rates, total litter sizes at birth and weaning, and litter weight at both birth and weaning. This enhancement in litter size and reduced mortality rates at weaning may be attributed to increased milk production and improvements in the metabolism of the essential and volatile oils found in the medicinal plants (Evans and Pharm, 1975). And also, this improvement according to Hamodi and AL-Khalain (2001) could be due to the active compounds that are present in Roselle (anthocyanin and protocatechuic acid) and its content of vitamin C, which had a positive effect on all cell activity and increase oxygen (O_2) consumption and as a result stimulate thyroid gland, which play a major role in metabolism.

Effect of dietary treatments on milk yield and chemical composition

Data in Table 4 presents the effects of various experimental treatments on milk yield and chemical composition. The groups of does that were fed diets supplemented with 0.05% or 0.1% roselle flower, as well as those receiving 0.05% anise seeds or a combination of 0.05% anise seeds and 0.05% roselle flower, demonstrated significantly higher milk yields on days 14 and 21 compared to the control group. In contrast, the does that were given diets with 0.1% anise showed a notable reduction in milk yield on days 14, 21, and 28 in comparison to the other groups.

The chemical composition of dry matter, protein, and ash in milk showed no significant differences across the various treatments. However, the fat and lactose content in the milk significantly ($P<0.05$) increased when supplemented with roselle flower, anise seeds at a concentration of 0.05%, and a combination of 0.05% anise seeds and 0.05% roselle flower in comparison to the control group. In contrast, there were no significant differences in fat and lactose levels when 0.1% roselle was used compared to the control group. In this context, Abdel-Rahman (2016) noted a significant increase in milk yield on the 21st day of the lactation period when fenugreek seeds were added to the rations of rabbit does. More recently, Sallam et al. (2019) reported that the total milk yield and production during the 2nd and 3rd weeks of lactation were significantly higher in rabbit does fed diets supplemented with either 6% fenugreek or a combination of 3% fenugreek and 3% anise seeds as

Table 4. Effect of rosella flower (*Hibiscus Sabdariffa)* and anise Seeds *(Pimpinella Anisum* L*)* supplementation on milk yield in the weight pre-and post-suckling and chemical compassion of milk.

Items	Treatments groups					
	Control	Rosella flower 0.05	Rosella flower 0.10	Anise seeds 0.05	Anise seeds 0.1	0.05 Rosella flower +0.05Anise seeds
Milk yield in the weight pre-and post-suckling						
At 7 days	69.42	80.50	76.77	79.88	72.85	79.60
At 14 days	86.00 [b]	105.90 [a]	101.11 [a]	105.55 [a]	91.00 [b]	112.00 [a]
At 21 days	132.43 [b]	146.60 [a]	143.22 [a]	146.22 [a]	122.85 [c]	145.70 [a]
At 28 days	80.14 [a]	89.60 [a]	83.66 [a]	86.44 [a]	66.28 [b]	85.50 [a]
Chemical compassion of milk (g)						
Dry matter	36.97	38.12	37.79	38.13	38.85	37.95
Protein	13.60	14.06	13.95	14.00	14.87	14.13
Fat	14.71 [c]	15.15 [b]	14.94 [bc]	15.24 [b]	16.64 [a]	15.01 [b]
Ash	2.81	2.86	2.91	2.78	2.92	2.67
Lactose	5.84 [b]	6.05 [a]	5.99 [ab]	6.11 [a]	4.41 [c]	6.13 [a]

a, b and c Means in the same row with different superscripts are significantly different (P<0.05). SEM: Standard error of the mean.

compared to other dietary treatment groups. Hendawy *et al.* (2019) demonstrated that incorporating black seed or ginger fine powder into ewe diets significantly enhanced the percentage of milk fat and total solids compared to the control group. El-Desoky *et al.* (2022) found that adding 10 mg of *Moringa oleifera* leaf ethanolic extract to rabbit diets resulted in significant increases in both milk yield and composition (including protein, total solids, and energy content). The enhancement in milk yield among rabbit does fed diets supplemented with anise seeds is attributed to the presence of anethole in anise seeds, a phytoestrogen, along with other compounds such as chlorogenic acid, naringenin, gallic acid, ellagic acid, taxifolin, caffeic acid, syringic acid, eugenol, trans-anethole, cis-anethole, methylchavicol, anisaldehyde, estragole, anisketone, linalool, coumarins, catechins, scopolin, umbelliferone, estrols, and beta-farnesene. Anise is considered a potential galactagogue (Sibeko *et al.,* 2021) and is included in some proprietary blends marketed for increasing milk supply; however, it is important to note that the use of galactogogues should not replace a thorough evaluation and counseling on modifiable factors that influence milk production (Badawi *et al.*, 2016). Furthermore, certain medicinal plants are known to possess lactogenic properties with the

capability to enhance serum prolactin levels, which is the primary lactogenic hormone secreted by the anterior pituitary (Gaya *et al*., 2009).

Data in Table (5) presents the plasma concentration values for total antioxidant capacity, superoxide dismutase activity, glutathione reductase, and thiobarbituric acid reactive substances. The results indicated that adding anise seeds and roselle flower to the diets of doe rabbits significantly ($P<0.05$). enhanced the concentrations of total antioxidant capacity, superoxide dismutase activity, and glutathione reductase. Conversely, the levels of thiobarbituric acid reactive substances significantly ($P<0.05$). decreased with the supplementation of anise seeds and roselle flower. Recent studies have demonstrated the potential benefits of antioxidant-rich diets on animal health. El-Gindy et al. (2022) discovered that supplementation with garden cress seeds in the diet resulted in a significant increase in total antioxidant capacity (TAC) and superoxide dismutase (SOD) activity compared to a control group. Subsequently, Notably, this resulted in a significant increase in the activities of antioxidant enzymes (glutathione peroxidase and superoxide dismutase) in all treatment groups compared to the control. In a separate study, Amer *et al.* (2022) added varying concentrations of Hibiscus sabdariffa L. extract to chick diets and observed a notable increase in serum TAC and SOD levels. Moreover, the serum malondialdehyde (MDA) level, a marker of oxidative stress, was decreased at higher concentrations of the extract.

Immunoglobulin concentration

A recent analysis (Table 6) revealed that the levels of certain antibodies, including immunoglobulins IgA, IgG, and IgM, increased significantly ($P<0.05$). in rabbits consuming diets supplemented with anise seeds and rosella flowers compared to those fed a control diet. This enhancement in IgG suggests a boost in antibody production, indicating a potentially strengthened immune response. Notably, the elevated levels of IgM, primarily found in lymph fluid and blood, are indicative of recent exposure to pathogens, as this antibody plays a crucial role in neutralizing pathogens early in the disease process. Recent studies suggest a positive correlation between Moringa oleifera and Hibiscus sabdariffa extracts, and their potential immune-enhancing properties. A study by El-Desoky *et al*. (2022) discovered that supplementing rabbit diets with a 10mg dose of Moringa oleifera ethanolic extract increased colostrum immunoglobulin concentrations, specifically IgG, IgA, IgM, and IgD, while leaving IgE levels unaffected. Meanwhile, Hibiscus sabdariffa L. extracts have been employed as immune-stimulants due to their rich flavonoid content, which includes anthocyanin and quercetin with notable antioxidant properties.

Table 5. Effect of rosella flower (*Hibiscus Sabdariffa)*and anise seeds *(Pimpinella Anisum* L*)* supplementation on blood antioxidant status.

Items	Treatments groups						SEM	P-value
	Control	Rosella flower 0.05	Rosella flower 0.10	Anise seeds 0.05	Anise seeds 0.1	Rosella Flower + Anise seeds		
Blood antioxidant status								
TAC, (U/mL)	0.94 [b]	1.28 [a]	1.32 [a]	1.27 [a]	1.31[a]	1.34 [a]	0.11	0.016
SOD, (U/mL)	43.2 [b]	61.93 [a]	65.65 [a]	62.93 [a]	63.75[a]	65.96 [a]	4.15	0.031
GPx, (U/mL)	7.38 [b]	9.32 [a]	9.59 [a]	9.26 [a]	9.52[a]	9.88 [a]	0.56	0.018
GR, (U/mL)	13.69 [b]	19.65 [a]	20.35 [a]	19.50 [a]	19.95[a]	20.76 [a]	1.07	0.022
TBARS, (U/mL)	22.44 [a]	18.74 [b]	17.88 [b]	18.87 [b]	18.05 [b]	17.33 [b]	1.36	0.011

[a-c]: Means in the same row having different superscripts differ significantly (P≤0.05).
SEM: Standard error of the means.
TAC: Total antioxidant capacity, SOD: Superoxide dismutase activity, GPx: Glutathione peroxidase , GR: Glutathione reductase, TARS: Thiobarbituric acid reactive substances

Table 6. Effect of rosella flower (*Hibiscus sabdariffa)* and anise seeds *(Pimpinella Anisum L)* supplementation on immunoglobulin concentration.

Items	Experimental groups						SEM	P-value
	Control	Rosella flower 0.05	Rosella flower 0.1	Anise seeds 0.05	Anise seeds 0.1	Rosella flower+ Anise seeds		
IgA (mg/dL)	157.12 [b]	187.05 [a]	195.77 [a]	187.80 [a]	191.62 [a]	195.27 [a]	7.82	7.82
IgG (mg/dL)	191.39 [b]	211.07 [a]	223.82 [a]	211.01 [a]	226.82 [a]	227.06 [a]	6.33	6.33
IgM (mg/dL)	118.83 [b]	148.12 [a]	153.81 [a]	149.27 [a]	152.67 [a]	160.44 [a]	11.06	11.06

a, b and c Means in the same row with different superscripts are significantly different (P<0.05). SEM: Standard error of the mean.

Research by Amer *et al*. (2022) found that feeding chickens a diet supplemented with 100g of Hibiscus sabdariffa L. extract significantly boosted the immune expression of IgG in the spleen. Furthermore, a study by Ali *et al*. (2016) indicated that Hibiscus sabdariffa extracts may possess multiple health benefits, including increasing hemoglobin (Hb) and red blood cell (RBC) levels, thereby aiding in the treatment of anemia.

Additionally, they observed a potential increase in blood volume and enhanced immunity through increased granulocyte counts. These findings highlight the potential of Moringa oleifera and Hibiscus sabdariffa extracts in promoting immune function and overall health.

Economic efficiency

The economic efficiency (%) of the present experimental treatments was calculated based upon input-output analysis of the total feeding cost/doe and the prevailing selling price of the litter/doe at weaning (Table 7).

The present results indicate an increase of total and net relative revenue for rabbits fed on diets supplemented anise seeds and rosella flower compared to other treatments. it can be noticed that rabbits fed diets supplemented 0.05 rosella flower +0.05anise seeds and diets supplemented 0.05 rosella flower were achieved the highest economical efficiency (152.00 and 145.72) and relative economic efficiency (162.25 and155.55) followed by rabbits fed diets supplemented 0.05anise seeds(152.80) and the least was the rabbits fed control diets.

These results are in harmony with those of diet achieved Fayed and Azoz (2018) found that Supplementation of feed additives rocket (Eruca Sativa) seeds and carrot (Daucus Carota L) seeds or bay laurel leaves (Laurus Nobilis L.) had the highest values of economic efficiency and relative economic efficiency compared to control.

Conclusively, the current study demonstrated that incorporating rosella flower and anise seeds as natural feed supplements in the diet of rabbit does can positively impact their performance, milk yield, and blood antioxidant levels. Consequently, these supplements may be beneficial for enhancing immune response.

Table (7) Effect of rosella flower (*Hibiscus Sabdariffa*) and anise seeds *(Pimpinella Anisum* L*)* supplementation on economic efficiency

Items	Experimental groups					
	Control	Rosella flower 0.05	Rosella flower 0.10	Anise seeds 0.05	Anise seeds 0.1	Rosella flower +Anise seeds
Price/kg diet	17.800	17.90	18.00	18.015	18.03	18.01
Total feed consumed doe/ gestation period,kg	6.524	6.225	6.233	6.183	6.000	6.330
Total feed consumed doe/suckling period/kg	7.547	7.530	7.528	7.482	6.759	7.000
Total feed cost /doe (LE)	250.46	246.21	247.69	246.10	230.04	240.07
Litter size at weaning	4.14	5.50	5.11	5. 44	4.71	5.50
Total revenue/Litter at weaning (LE)[1]	485.1	605	562.13	598.4	518.1	605
Net revenue/d (LE)[2]	234.64	358.79	314.44	352.3	288.06	364.93
Economical efficiency (LE)[3]	93.68	145.72	126.94	143.15	125.22	152.00
Relative economical efficiency	100	155.55	135.50	152.80	133.66	162.25

[1] Total revenue = Litter size x110, assuming that the selling price of each rabbit at weaning was LE (110).

[2]Net revenue/ rabbit doe (LE) = Total revenue/ rabbit doe (LE) - Total feed cost / rabbit doe (LE).

[3]Economic efficiency = Net revenue/ rabbit doe/ Total feed cost / rabbit doe (LE).

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الأداءاالتناسلي والاستجابة الفسٍولوجية لأمهات الأرانب المتأثرة بأضافة زهرة الكركدية وبذور الينسون.

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الهدف: أجريت هذة التجربة لدراسة تأثير إستخدام زهرة الكركدية وبذور الينسون كأضافات غذائية على الصفات التناسلية والفسيولوجية لأمهات الأرانب النيوزيلاندي الابيض.

الطريقة: تم تقسيم 30 أم نيوزيلاندي أبيض عشوائيا عمر ٥ اشهر بمتوسط وزن 2.984 ± 125.76جم الى ٦ مجموعات تجريبية (٥ أرانب فى كل منها .أضيفت زهرة الكركدية وبذور الينسون الى عليقة الكنترول بمستويين 0.05% (0.5 جم /كجم) و 0.1% (1.0 جم /كجم).

النتائج: وجد تأثير معنوى فى التغير فى وزن الجسم أثناء فترة الحمل والرضاعة عند أضافة (0.05% زهرة الكركدية بالمقارنة بالمعاملات الاخرى وجد تحسن معنوى عند أضافة زهرة الكركدية بمستويين(0.05%) 0.1% , (0.05%) بذور الينسون و زهرة الكركدية (0.05%) + بذور الينسون(0.05%). anise seeds (0.05%) فى معدل الحمل, عدد ووزن الخلفات ,وزن الخلفات (g/ h) ووزن الخلفات المكتسب من الولادة حتى الفطام وهذا أدى الى انخفاض معنوى فى النسبة المئوية للنفوق .كما وجد عدم تأثير معنوى فى المأكول، وجد تأثير معنوى فى كمية اللبن والتركيب الكيماوى للدهن والالكتوز بأضافة 0.05% مستوى زهرة الكركدية وبذور الينسون و زهرة الكركدية (0.05%) + بذور الينسون(0.05%) بالمقارنة بالكنترول.

أظهرت النتائج أضافة زهرة الكركدية وبذور الينسون total antioxidant capacity, زيادة معنوية الأجسام المناعية IgA, IgG وIgM لكن وجد انجفاض فى superoxide dismutase activity, glutathione reductase thiobarbituric acid reactive substances

التوصية: أظهرت النتائج أن أضافة زهرة الكركدية وبذرة الينسون بمعدل 0.05% و زهرة الكركدية الآرانب0.05%+بذرة الينسون 0.05% الى علائق أمهات الآرانب حسنت من الصفات التناسلية والفسيولوجية.