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IMPACT OF *Posidonia oceanica* AS A PARTIAL SUBSTITUTE OF ALFALFA HAY ON PRODUCTIVITY AND REPRODUCTIVITY OF NZW RABBITS UNDER NORTH SINAI CONDITIONS

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ABSTRACT

This study included two trials, the first trial aimed to evaluate the effect of using varying levels of *Posidonia oceanica* (PO) as untraditional feed ingredient instead of alfalfa hay in rabbit's diets on growth performance, carcass traits, lipid profile and hematological parameters. The second trial aimed to assess the effect of PO diets on physiological aspects and semen traits of male rabbits. The first trial, forty-eight weaned New Zealand white (NZW) were divided randomly into four comparable groups. First group was fed on basal diet while, the other treatment groups were fed on diets containing 7.5, 15 and 22.5 % of PO, instead of alfalfa hay in rabbit's diets, respectively. Results demonstrated that inclusion of PO in rabbits' diets didn't significantly affect either growth performance or carcass traits. For lipid profile, very-low-density lipoprotein (VLDL) and non-high-density lipoprotein cholesterol (NON-HDL) were significantly affected by dietary treatments. For hematological parameters, there were no significant differences among treatment groups except platelets and MCHC. The second trial, three male rabbits from each group were chosen and fed the same diets of the first trial. At (5-6 months age), some physiological aspects and semen quality were evaluated. No significant differences were observed in rectal temperature, pulse rate, respiration rate and semen quality traits except count and concentration however, they increased with increasing level of PO in diets. Therefore, it could be concluded that rabbits fed on diets containing PO up to 22.5% did not show any detrimental effects on growth performance, carcass traits, lipid profile, hematological parameters and semen quality.

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INTRODUCTION

Rabbit production contributes to closing the dietary gap caused by animal protein deficit. However, rabbit competes less directly with human for food than poultry. Rabbit is considered as pseudo-ruminant that is raised for highly nutritive proteins and low-fat contents (**Hamid *et al*., 2019**). Rabbits can be successfully raised on diets containing fibrous by- products (**Cheeke, 1986**). This fibre not only provides nutrients but also balance of gastrointestinal tract, promoting digestive system development raising the reproductive performance (**GU, 2002**). Due to the high expense of feeding rabbits on the conventional feedstuffs, some untraditional feeds with reasonable nutritional value can be used to minimise the costs of the nutrition. **(Khayyal *et al*., 2017, Bakr *et al*., 2019, Bakr *et al*., 2021)**.

Using sea grass for animal feed, especially ruminant animal feed, should be placed on the agenda of global animal nutrition programs to solve the problem of feed shortage of the world. Nutritional studies of sea grasses should be conducted on the basis of their local availability

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(**Torbatinejad *et al*., 2007).** Amongst these sea grasses, *Posidonia oceanica* is widely spread in the Mediterranean Sea **(Davis, 1984).** It consists of compounds such as amino acids **(Augier and Santimore, 1979)**, sterols **(Sica *et al*., 1984),** fatty acids **(Viso *et al*., 1993),** carbohydrates **(Invers *et al*., 2004)** and high concentration of phenolic compounds **(Grignon-Dubois and Rezzonico, 2015). Castillo *et al*. (2015)** showed that PO contains 42 g/kg DM CP, 155 g/kg DM Ash, 13 g/kg DM EE, 760 g/kg DM ADF; 533 g/kg DM NDF and 116 g/kg DM ADL. The NDF values found in PO indicate its potential use as a source of fiber in the diets of ruminants.

Therefore, the aim of this work was to assess the effect of (*Posidonia oceanica*) inclusion as untraditional feed ingredients in rabbits' diet on growth performances, carcass traits, lipid profile and semen quality of New Zealand white rabbits under North Sinai conditions.

MATERIALS AND METHODS

This study was conducted in the Rabbitry Farm, Department of Animal and Poultry Production, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai, Egypt, the present study lasted for five months starting middle of April till the middle of September 2022. This study included two trials, the first trial aimed to assess the effects of using varying levels of *Posidonia oceanica* (L.) Delile (sea-grass) as untraditional feed ingredient instead of alfalfa hay in rabbit's diets on growth performance carcass traits, lipid profile and hematological parameters. The second trial aimed to assess the effect of diets containing varying levels of PO on physiological aspects and semen traits of male rabbits under North Sinai environmental conditions.

Collection and Preparation of *Posidonia oceanica*

PO (all the parts of the plant) fresh, was collected from Bardawil lake from the area around it in North Sinai, Egypt during the period (May – June 2021) and sun- dried for two days, until the moisture content was about 10%. It was turned several times to maintain its greenish coloration. The dried PO were grinded, sieved (1mm mesh), mixed and stored in tight polyethylene until use. Samples (PO) and experimental diets were brought to laboratory in plastic bags for chemical analysis according to **AOAC (2012)**.

Animals and Experimental Design

The first trial

Forty-eight newly weaned New Zealand White (NZW) unsexed (six weeks old and 749.34 g average body weight ± 24.22) were divided randomly into four treatment groups. The first group (CON) was fed on pelleted control diet while, the other treatment groups (SGR1, SGR2 and SGR3) were fed on diets containing 7.5, 15 and 22.5 % of PO, respectively substituting 25, 50 and 75% alfalfa hay, respectively. PO was mixed with feed ingredients then; the experimental diets were pelleted under temperature 65-70ºC at 0.4 cm. thickness and 2 cm. length. The composition and chemical analysis of *posidonia oceanica* and the experimental diets are showed in Table 1. The experimental diets were formulated to meet the nutrients needs of growing rabbits according to **NRC (1977)**. The rabbits were housed in galvanized wire cages (batteries) with standard dimensions of (40*40*30) (3/cage).

The rabbits were raised under similar management (temperature and relative humidity), hygienic conditions (vaccinations and health care) in well- ventilated building (light and natural air through windows). The daily amount feed was offered one time a day at 08:00 h for all groups and drinker water and feed were provided *ad libtim* during the experimental period. Individual body weight and feed intake were determined weekly. Body weight gain and feed conversion ratio (feed/gain) were calculated.

Table 1. Ingredients composition and chemical analysis of *posidonia oceanica* and experimental diets

Items	Dietary treatment groups*			
	CON	SRG1	SRG2	SRG3
Alfalfa hay (15%)	30.0	22.5	15.0	7.5
posidonia oceanica	-	7.5	15.0	22.5
Yellow corn	10.55	10.55	10.55	10.55
Soybean meal (44%)	15.0	15.0	15.0	15.0
Wheat bran	25.15	25.15	25.15	25.15
Barley	16.50	16.50	16.50	16.50
Salt	0.30	0.30	0.30	0.30
Premix**	0.30	0.30	0.30	0.30
Limestone	1.05	1.05	1.05	1.05
Di-Calcium Phosphate	0.95	0.95	0.95	0.95
Anti- Coccidia	0.1	0.1	0.1	0.1
Anti- Fungi	0.1	0.1	0.1	0.1
Total	100	100	100	100

Chemical analysis (%) of alfalfa hay, *Posidonia oceanica*, and experimental diets as DM basis

Item	Alfalfa hay***	*Posidonia oceanica*	Dietary treatment groups			
			CON	SGR1	SGR2	SGR3
DM%	87.56	87.70	93	92.50	91.50	91.40
On DM basis						
OM	89.32	65.45	91.61	89.87	88.04	86.30
CP	16.27	11.52	17.85	17.61	17.46	17.14
CF	30.24	11.53	13.93	12.67	11.47	10.13
EE	2.68	1.17	3.24	3.14	3.07	2.96
NFE	40.13	41.23	56.59	56.45	56.04	56.07
ASH	10.68	34.55	8.39	10.13	11.96	13.70
DE (Kcal /kg feed DM) ****	-	-	3154	2980	2862	2786

*Dietary treatment groups; CON = Control, basal diet containing zero sea grass (PO), SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO.

** One kilogram of premix contains vit. A 12000 000 IU, vit. D3 2200 00 IU, Vit. E 1000 mg, Vit. K3 2000 mg, Vit. B1 1000 mg, vit. B2 4000 mg, Vit. B6 100 mg, vit. B12 10 mg, pantothenic acid 3.33 g, biotin 33 mg, folic acid 0.83 g, choline chloride 200 g, Zn 11.79g, Mn 5 g, Fe 12.5g, Cu 0.5g, I 33.3 mg, Se 16.6 mg and Mg 66.7 g.

***According Abd-Allah (2017).

****DE (Kcal/kg feed DM) was calculated according to NRC (1977).

At the end of the feeding trial (14 weeks of age), 16 rabbits (4/each) were chosen to slaughter to evaluate carcass traits, lipid profile and hematological parameters. Rabbits were individually weighted and slaughtered after fasted 12 hours. The empty carcass with head, liver, heart and kidneys were weighted separately according to **Cheeke (1987)** and calculated as percentage of pre-slaughter weight (%).

From each rabbit, paired blood samples were collected. The first sample was collected in a heparinized tube for hematological studies which determined the collection day. The second sample was collected in a clean, non- heparinized tube and allowed to clot at room temperature and then centrifuged at 3000 rpm for 15-20 min, then the serum was separated and stored at -20 C until analyzing. Lipid profile such as total cholesterol and triglycerides were determined by using commercial kits. High-density lipoprotein (HDL) was determined according to **Siedel (1983)**. Low-density lipoproteins (LDL) and very low-density lipoprotein (VLDL) were estimated Friedewald equation (Low-density lipoprotein= Total cholesterol-High density lipoprotein cholesterol-(triglycerides/5), VLDL = (triglycerides/ 5) (**Friedewald *et al*., 1971**).

Blood hematological parameters such as hemoglobin (HG), Packed cell volume (PCV) red blood cells (RBCs), mean capsular volume (MCV), mean corpuscular hemoglobin (MCH), and red cell distribution width (RDW), mean corpuscular hemoglobin concentration (MCHC) and platelets (plate) were measured. Total and differential leukocyte count (lymphocytes (LYMPH), neutrophils (NEUTTR), SEGM, BANDS, Monocytes (MONO), Eosinophils (EOSIN) and Basophils (BASO) %) were determined according to **Schalm *et al*. (1975)** cited by **Abou-Shehema *et al*. (2023**.

The second trial

At the end of feeding trial, three males were chosen from each treatment group and fed on the same experimental diets which used during the feeding trail (CON, SGR1, SGR2 and SGR3).

At 5-6 months age and average weight 3.236 ± 0.16 kg, ambient temperature and relative humidity values were noted once a day at 13.30 PM. during the experimental period to estimate temperature humidity index (THI) according to **LPHSI (1990)** modified by **Marai *et al.*, (2001).** Using this formula:

THI=T- [(0.31- 0.31*RH) *(T-14.4)]

Where:

T =dry bulb temperature (in Celsius).

RH= relative humidity (percentage) ÷100

The values obtained were classified as follows: less than 27.8 =Absence of heat stress, 27.8 - <28.9 =Moderate heat stress, 28.9- < 30.0 =Severe heat stress and 30.0 and more 30.0 = Very severe heat stress.

Physiological aspects such as rectal temperatures (C^{o}), pulse rates (Score) and respiration rate (Score) were recorded at 12:00 PM. for two days per week, during the experimental period. The rectal temperature for each animal was measured using a clinical digital thermometer. Pulse rate was recorded by placing a fingertip on the femoral arteries of the hind limb for one minute. Respiration rate (breaths/minute) was measured by counting the frequency of flank movements/minute (**Ayyat *et al*., 2018**).

Semen was collected two days weekly to evaluate physical traits, the ejaculates of semen were collected using a teaser doe and artificial vagina. Reaction time (in sec.) was assessed just from the time the teaser doe was introduced to the buck until the buck begun mount. It was measured by stopwatch in seconds. Reaction time, volume of ejaculate, sperm concentration, sperm abnormality and sperm livability were measured according to **Attia and Kamel, (2012)**.

Statistical Analyses

Data were statistically analyzed using Least Squares Analysis of Variance according to **Snedecor and Cochran (1982)** using the **SAS (2004)** using the following fixed model for rabbits:

$$Yij = \mu + Ti + e_{ij}$$

Where, Yij = the observed value of a given dependent variable, μ = Overall adjusted mean, Ti = Effect of using varying levels of *Posidonia oceanica* (PO) in rabbit's diets (i = 1, 2 ,3 and 4) and eij = Random error.

The differences between LSM (least square means) were analyzed by Duncan's New Multiple Range test **(Duncan, 1955**).

RESULTS AND DISCUSSION

First Experiment

Some growth performance traits

Results in Table 2 showed that no significant differences among treatment groups in live body weight, daily weight gain and daily feed intake. Similarly, **Castillo (2015)** reported that supplementation with (PO), had no significant effect on body weight and milk production for dairy goats fed on ration containing PO. **Castillo *et al*. (2017)** presented that the addition of any quantity of PO above 15% in sheep ration led to a lower weight gain. Slightly decreasing was observed in live body weight and daily gain weight result of inclusion of PO in the rabbits' diets in the mentioned traits. This may be linked to lower feed intake in sea grass diets compared to CON diet. This is because of a lack of adaptation to PO during the study period **(Castillo *et al*., 2017)**.

Carcass traits

Data in Table 3 presented that PO inclusion in growing rabbits' diets at different levels (7.5, 15 and 22.5%) showed no significant effect on all traits of carcass (empty carcass with head, edible parts, total edible parts (dressing), non-edible parts and edible giblets as percentage of pre slaughter. These results indicate that using PO up to 22.5% had no adverse effect on carcass traits and internal organs. These results are in agreement with **Bakr *et al*., (2023),** who found that carcass traits of rabbits fed diets containing 10% sea grass (*cymondocea nedosa*) did not differ as compared to that fed on control diet. Liver, kidneys and heart (the internal organs) were in normal size and no signs of toxicity were observed.

Lipid profile

Data in Table 4 showed that no significant differences in most of lipid profile (total cholesterol, triglycerides, HDL and LDL) except VLDL. For total cholesterol, triglycerides and LDL, Means tended to be lower in rabbits received diets containing PO compared to that received CON diet. This may be due to PO contains β-sitosterol as a bioactive component which may be partly responsible for the hypercholesteremic effect (**Mbikay, 2012**). There was a tiny fluctuation in HDL values among treatment groups. It is clear that VLDL concentrations of rabbits decreased significantly with the increasing of PO levels in the diets. However, VLDL of rabbit received 22.5% PO (SGR3 diet) was lower ($P< 0.05$) than those of rabbit received 7.5%PO (SGR1 diet) but didn't differ significantly with other two groups (CON and SGR2). Similarly, **Kolsi *et al*. (2017)** reported that *C. nodosa* extract (CNE) decreased triglycerides, LDL and total cholesterol levels in the plasma of diabetic rats, and increased HDL cholesterol, that helped maintain the balance of blood lipids when compared with diabetic rats. In the same trend **Walaa (2020)** showed that total cholesterol and triglycerides of rabbits fed on seagrass (*Cymodocea nodosa*) were decreased numerically compared to those fed on control diet (Table 4).

Table 2. Live body weight (initial and final), daily body weight gain and daily feed intake(g.) of growing rabbits as effected by dietary treatments (*Posidonia oceanica)* ($\bar{X}$±SE) from 6 to 14 weeks of age.

Items	Dietary treatment groups*			
	CON	SGR1	SGR2	SGR3
Initial weight, g	750.00±25.88	750.00±24.56	749.17± 22.17	748.00±24.26
Final weight, g	2326.67±55.90	2269.17±64.10	2245.00±57.43	2252.00±40.93
Daily weight gain, g	29.35±0.717	27.13±1.036	26.71±1.003	26.86±0.825
Daily feed intake, g	106.0±3.100	102.9±2.854	102.02±1.752	102.62±4.092
Feed conversion (g feed/g gain)	3.61±0.065	3.79±0.036	3.82±0.048	3.82±0.139

*Dietary treatment groups; CON = Control, basal diet containing zero PO, SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO.

Table 3. Carcass traits (% of pre-slaughter wt.) of growing NZW rabbits as influenced by dietary treatment (*Posidonia Oceanica*) (Means ±SE) at 14 weeks of age

Item	Dietary treatment groups*			
	CON	SGR1	SGR2	SGR3
Pre-slaughter wt. (g)	2457.5±41.51	2292.5±117.8	2290.0±122.5	2315.0±103.5
Empty carcass	58.73±1.421	57.10±0.455	56.93±0.996	56.97±0.775
Edible parts[1] (Dressing)	62.17±1.285	60.32±0.627	60.17±0.999	60.33±0.939
Edible giblets[2] :	3.440±0.245	3.214±0.180	3.245±0.012	3.354±0.275
Liver (%)	2.613±0.224	2.316±0.145	2.374±0.03	2.446±0.244
Kidneys (%)	0.527±0.020	0.603±0.038	0.603±0.033	0.608±0.031
Heart (%)	0.300±0.024	0.295±0.018	0.268±0.005	0.301±0.020
Head (%)	4.935± 0.126	5.265±0.163	5.3971±0.216	4.911±0.077
Non- Edible parts[3]	37.83±1.285	39.68±0.627	39.83±0.999	39.67±0.939
Lungs	0.432^{b}±0.033	0.498^{ba}±0.033	0.548^{a}±0.036	0.494^{ba}±0.020

[a and b]: Means within the same row with different superscripts are significantly different (P<0.05).
*Dietary treatment groups; CON = Control, basal diet containing zero PO, SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO
[1]Total Edible parts (Dressing%) = Total edible parts wt. / Pre-slaughter wt.
[2]Edible giblets%= Liver% +Kidneys% +Heart%
[3]Non- Edible parts%= 100- Dressing%

Table 4. Lipid profile (mg/dl) of growing rabbits as influenced by dietary treatment *(posidonia oceanica*) .X-±SE) at 14 weeks of age.

Items	Dietary treatment groups*				Normal range**
	CON	SGR1	SGR2	SGR3	
Total cholesterol	70.00±8.32	67.00± 4.26	69.00±8.26	53.75±7.33	10-100
Triglycerides	81.25±8.05	85.25± 13.49	73.00±4.18	59.25±1.93	50-200
HDL	27.000±2.80	25.500±0.96	26.500±1.26	27.500±2.06	-
LDL	26.750±7.09	24.500±5.14	28.00±8.78	14.500±5.91	-
VLDL	16.000^{ab}±1.47	17.250^{a}±2.69	14.50^{ab}±0.96	11.750^{b}±0.48	-

[a and b]: Means within the same row with different superscripts are significantly different (P<0.05).
* Dietary treatment groups; CON = Control, basal diet containing zero PO, SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO
** According to **Manning *et al*. (1994)**
HDL =High-density lipoprotein
LDL=Low-density lipoproteins
VLDL= Very low-density lipoprotein

Hematological parameters

Blood hematological parameters are valuable in monitoring toxicity of feed (**Oyawoye and Ogunkunle, 1998**). Dietary treatments (Table 5) hadn't affect (P>0.05) most of hematological parameters (HG, PCV RBCs, MCV, MCH, and RDW) except MCHC and PLATE. However, SGR2 treatment (15%PO) reduced (P<0.05) MCHC compared with the CON group but didn't differ significantly with the other two treatment groups (SGR1 and SGR3) as shown in Table 5. There was numerical decrease in HG, PCV and RBCs with increasing PO in diet without significance. Mean values of MCV, MCH and RDW in all groups were almost comparable. The values obtained were in the normal range are reported by **Manning *et al*. (1994)**. This suggests that the rabbits responded well to the experimental diets (PO). It is clear that dietary treatments effected on plates. However, mean value of platelets in SGR1 was higher (P<0.05) than those either of CON or SGR3. Between CON, SGR2 and SGR3, there were no significant differences.

Total and differential leukocyte count

Data in Table 6 showed no significant differences among treatment groups in total and differential leukocyte count (LYMPH, NEUTTR, SEGM, BANDS, MONO, EOSIN and BASO%) except BANDS (%). Mean values of WBC were numerically decreased with increasing PO in diet. WBC value of CON group was higher than the normal level of healthy rabbits. This shows the existence of recent infection of bacteria (**Ahamefule *et al*., 2008**). While WBC means of groups that fed on PO diets (SGR1, SGR2 and SGR3) were in the normal range of healthy rabbits. This implies that PO improved the immune system of rabbits. BANDS value was affected significantly by PO inclusion in rabbit diets. It was higher (P<0.05) in SGR1 and SGR2 than CON group. Whereas, there were non-significant differences among rabbits fed PO diets (SGR1, SGR2 and SGR3). Total and differential leukocyte count were within the normal range of healthy rabbits (**Hewitt *et al*., 1989 and Thrall *et al*., 2012**). It explains that the immune system of rabbit fed PO diets was in normal statue. The non-significant (P>0.05) influence of diet on most of the hematological parameters suggest that the experimental diets are nutritionally adequate and safe. **Linday, (1977)** reported that abnormal values or decrease in parameters

Table 5. Hematological parameters of growing rabbits as effected by dietary treatment groups (*Posidonia oceanica)* ($\bar{X}$±SE) at 18 weeks of age

Item	Dietary treatment groups*				Normal range**
	CON	SGR1	SGR2	SGR3	
HG mg/dl	13.70±0	12.93±0.54	12.68±0.36	12.88±0.53	11.5-15.1
PCV %	39.40±0.72	37.58±0.84	38.38± 1.22	37.93±1.08	36.6- 47.4
RBCs ($\times10^6$/ µL)	6.72±0.07	6.69±0.16	6.40±0.15	6.40±0.07	3.7-7.5
MCV (Fl)	58.70±1.53	56.28±1.76	60.05±1.66	59.30±2.01	58-79.6
MCH (pg.)	20.37±0.21	19.38±0.96	19.85±0.42	20.13±0.92	19.2-29.5
MCHC (%)	34.83^{a}±0.63	34.35^{ba}±0.75	33.03^{b}±0.19	33.93^{ba}±0.43	31.1-37
RDW (%)	12.93±0.16	12.88±0.24	12.98±0.17	12.93±0.17	-
PLATE ($\times10^3$/ µL)	587.8^{b}±20.472	712.0^{a}±16.75	638.0^{ab}±20.02	628.0^{b}±37.25	112-795

a and b: Means within the same row with different superscripts are significantly different (P<0.05).
* Dietary treatment groups; CON = Control, basal diet containing zero PO, SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO).
** According to **Manning *et al*. (1994)**
HG= Hemoglobin
PCV= Packed cell volume
RBCs= Red blood cells
MCV= Mean capsular volume
MCH= Mean corpuscular hemoglobin
MCHC= Mean corpuscular hemoglobin concentration
RDW= Red cell distribution width
Plate= Platelets

Table 6. Total and differential leukocyte count of growing rabbits as effected by dietary treatments (*Posidonia oceanica)* ($\bar{X}$±SE) at 14 weeks of age

Item	Dietary treatment groups*				Normal range**
	CON	SGR1	SGR2	SGR3	
WBC ($\times10^3$/µL)	18.10±0.387	16.85±0.409	16.98±0.947	14.18±0.661	5.2-16.5
LYMPH (%)	65.50±1.936	64.00±1.225	65.250±0.854	66.50±0.289	43-80
NEUTTR (%)	31.00±1.683	32.50±1.041	31.50±1.041	30.50±0.289	34-70
SEGM (%)	29.43±1.607	30.45±1.133	29.50±1.041	28.65±0.233	-
BANDS (%)	1.567^{b}±0.209	2.050^{a}±0.126	2.000^{a}±0	1.850^{ab}±0.065	-
MONO (%)	2.392±0.231	2.250±0.250	2.250±0.250	2.000±0	0-4
EOSIN (%)	1.108±0.079	1.000±0	1.000±0	1.000±0	0-2
BASO (%)	0.00±0	0.25±0.25	0.00±0	0.00±0	0-0.84

a and b: Means within the same row with different superscripts are significantly different (P<0.05).
* Dietary treatment groups; CON = Control, basal diet containing zero PO, SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO.
** According to **Manning *et al*. (1994)**
WBC= White blood cells
LYMPH= Lymphocytes
NEUTTR= Neutrophils
MONO=Monocytes
EOSIN= Eosinophils
BASO= Basophils

of hematology may refer to low protein consumption, anemia or parasitic infection. These results showed that the animals were in good health because decreased in value of WBCs, less than the normal range is an indication of anaphylactic shock and some parasitism while high values indicate a recent infection, usually with bacteria (**Ahamefule *et al*., 2008**). The values for all the blood parameters of rabbits were in the normal established ranges (**Manning *et al*., 1994**). This may be due to their balance of nutrient profile.

Second Experiment

Temperature Humidity Index (THI)

Given that the average of THI for the experimental period was 25.16 which indicated absence of heat stress (less than 27.8). However Ambient temperature ranged between (25-28.2◦C); and relative humidity was (62.6- 74.4%) as shown in Table 7.

Rectal temperature, pulse and respiration rate of bucks

As shown in Table 8. It is clear that diets containing PO up to 22.5% didn't affect on rectal temperature, pulse rate and respiration rate. However, mean rectal temperature was ranged (39.03-39.23ºC), pulse rate (118.33-122.33 movements/min) and respiration rate (107-115 breaths/min). Rectal temperature in this study lies in the same range whereas respiration rate was higher than obtained by **Ibrahim (2016).** On contrary**, Ayyat *et al*., (2018)** found that rectal temperature, respiration rate and pulse rate of growing rabbits were 38.61ºC, 71.76 breaths/min and 144.84 movements/min respectively in summer but were 37.95ºC, 67.24 breaths/ min and 141.04 movements/min respectively in winter.

Means of mentioned aspects were lies less than the range obtained by **Abdel-Samee *et al*. (2014).** This is may be due to absence of heat stress (THI <27.8) (**Marai *et al*., 2001**).

Male Sexual Behaviour (Reaction time) and Semen Characteristics

Semen physical traits

It is clear that, feeding rabbit on diets containing PO up to 22.5% had no significant effect on semen physical traits (reaction time, pH, volume, sperm abnormality and sperm livability). Reaction time of rabbits fed SGR1 and SGR2 diets was improved compared to the other two groups (CON and SGR3). Mean value of reaction time in all treatment groups ranged from 10.33 : 19.00 (Sec.). These results were within the range found by **El-Ratel *et al*. (2023)** who found that, reaction time of rabbit fed on diet containing Spirulina and selenium nanoparticles ranged 13.9 : 20.8 (Sec.). Values of pH values were almost the same in all treatment groups and lies in range obtained by **Youssef *et al*. (2003)**. Semen color was Crème white in all treatment groups. PO inclusion improved semen volume with no significant differences among treatment groups. Sperm abnormality values were nearly similar in all treatment groups and lies in range obtained by **El-Ratel *et al*. (2023).** Sperm livability values lie within the range obtained by **El-Ratel *et al*. (2023)**. The same authors reported that sperm livability values were lies within the range

Total sperm output and sperm cell concentration values of rabbits that fed on SGR1 and SGR3 diets, significantly increased ($P<0.05$) compared with the other groups (CON and SGR2). CON and SGR2 values were comparable (**Table 9**). The results are within that obtained by **El-Ratel *et al*., (2023) (Table 9)**. This improvement in semen quality of rabbit fed on PO diets can be attributed to antioxidants (poly phenol compounds) of *Posidonia oceanica* **(Messina *et al*., 2021).**

Table 7. Air temperature (AT), relative humidity (RH) and THI

Items	Air temperature, C°	Relative humidity (%)	THI
	Average	Average	
Wk. 1 and 2	26.01±0.18	71.72±0.52	24.99±0.16
Wk. 3 and 4	26.53±0.29	68.09±0.81	25.33±0.25
Overall mean	26.27	69.91	25.16

Table 8. Rectal temperature, pulse and respiration rate of bucks as effected by dietary treatments

Items	Dietary treatment groups*				
	CON	SGR1	SGR2	SGR3	F-test
Rectal temperature, C°					
Wk.1	39.23±0.120	39.10±0.173	39.20±0.058	39.23±0.120	0.855
Wk.2	39.20±0.058	39.13±0.033	39.20±0.058	39.13±0.033	0.595
Wk.3	39.10±0.058	39.03± 0.033	39.17± 0.067	39.23±0.120	0.348
Wk.4	39.03±0.145	39.17±0.088	39.10±0.058	39.00±0.058	0.731
Pulse rate (Score)					
Wk.1	122.33±0.333	121.00±0.577	120.67±0.882	122.67±0.882	0.2039
Wk.2	121.00±1.000	120.67±0.882	122.33±1.453	120.67±0.333	0.6318
Wk.3	120.67±1.202	120.00±0.577	120.33± 0.882	122.00±0.577	0.4167
Wk.4	118.33±1.856	121.00± 1.00	120.00±1.00	122.67±1.764	0.2773
Respiration rate (Score)					
Wk.1	111.00±1.155	113.33±1.453	110.33±3.844	113.33±1.856	0.7234
Wk.2	112.00±0.577	107.00±5.132	106.00±2.646	107.33±3.712	0.6813
Wk.3	110.33^{ba}±0.882	114.33^{a}±2.667	109.33^{ba}±4.401	103.33^{b}±2.848	0.0505
Wk.4	113.00±3.055	115.00±3.055	109.00±1.528	111.00±0.577	0.3544

$^{a \text{ and } b}$: Means within the same row with different superscripts are significantly different (P<0.05).

* Dietary treatment groups; CON = Control, basal diet containing zero PO, SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO

Table 9. Reaction time and semen quality of male NZW rabbits as affected by feeding (*posidonia oceanica)*) under Sinai conditions ($\bar{X}$±SE)

Item	Dietary treatment group*				F-test
	SGR3	SGR2	SGR1	CON	
Reaction time (sec.)	19.00±4.58	10.33±0.88	11.50±1.50	15.00±4.00	NS
Semen pH	8.10±0.055	8.24±0.11	8.15±0.05	8.015±0.005	NS
Semen volume (ml.)	0.71±0.27	1.12±0.27	1.13±0.100	1.21±0.062	NS
Total sperm output (10^6/ejaculate)	127.94^{b}±21.96	179.92^{a}±32.87	130.40^{b}±44.90	179.63^{a}±58.375	*
Sperm cell concentration (10^6/ml)	113.72^{b}±31.65	182.48^{a}±46.69	114.38^{b}±40.05	210.59^{a}±93.29	*
Sperm abnormality%	27.97±1.52	25.56±0.56	26.50±1.50	26.75±1.75	NS
Sperm livability%	62.22±8.94	59.57±2.95	65.00±7.50	62.500±5.00	NS

$^{a \text{ and } b}$: Means within the same row with different superscripts are significantly different (P<0.05).

* Dietary treatment groups; CON = Control, basal diet containing zero PO, SGR1= 7.5% PO, SGR2= 15% PO, and SGR3 = 22.5% PO

NS: No significant

* significant at P<0.05

Conclusion

It could be concluded that rabbits fed on diets containing PO up to 22.5% did not show any detrimental effects on growth performance, carcass traits, lipid profile, hematological parameters and semen quality.

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الملخص العربي

تأثير استخدام بوسيدونيا اوشينيكا كبديل جزئي لدريس البرسيم الحجازي على الأداء الإنتاجي والتناسلي للأرانب النيوزيلاندي البيضاء تحت ظروف شمال سيناء

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تضمنت الدراسة تجربتين، تهدف التجربة الأولى إلى تقييم تأثير استخدام مستويات مختلفة من *Posidonia Oceanica* (PO) بديلاً لدريس البرسيم الحجازي على الأداء الإنتاجي لها. بينما تهدف التجربة الثانية إلى تقييم تأثير *Posidonia Oceanica* على بعض الصفات الفسيولوجية والصفات الطبيعية للسائل المنوي لذكور الأرانب. في التجربة الأولى، ثمانية وأربعين ارنبا مفطومة، قسمت الى أربعة مجاميع. غذيت المجموعة الأولى على عليقة كنترول بينما غذيت المجموعات الثلاثة الأخرى على علائق تحتوي على 7.5، 15 و22.5% من البوسيدونيا على التوالي. اوضحت النتائج أن المستويات المختلفة من البوسيدونيا لم تؤثر على النمو، صفات الذبيحة، دهون الدم بينما كانت NON-HDL اقل معنوياً في المجموعة SGR3مقارنة بالمجموعات الثلاثة الأخرى. لم تتأثر صورة الدم معنوياً نتيجة المعاملات الغذائية باستثناء الصفائح الدموية وMCHC حيث انه MCHC كانت اقل معنويا في المجموعة SGR2مقارنة بالمجموعة CON، بينما كانت Plateletsأعلى معنويا في المجموعة SGR1مقارنة بالمجموعة CON،SGR3. في التجربة الثانية، تم اختيار ثلاثة أرانب ذكور من كل مجموعة وتم تغذيتهم على نفس العلائق التي غذيت عليها التجربة الأولى، في عمر (5-6 أشهر) تم تقييم بعض القياسات الفسيولوجية والصفات الطبيعية للسائل المنوي، لم تلاحظ فروق معنوية في درجة حرارة المستقيم ومعدل النبض ومعدل التنفس. بالنسبة للصفات الطبيعية للسائل المنوي ازداد العدد الكلي والتركيز معنويا في الحيوانات التي تغذت على البوسيدونيا مقارنة بالكنترول. يمكن تغذية الأرانب على علائق تحتوي على بوسيدونيا اوشينيكا بنسبة تصل إلى 22.5% دون تأثير ضار على النمو، صفات الذبيحة، مستوى الدهون، صورة الدم والصفات الطبيعية السائل المنوي. ونوصي بأنه يمكن تغذية الأرانب على علائق تحتوي على بوسيدونيا اوشينيكا بنسبة تصل إلى 22.5% دون تأثير ضار على النمو، صفات الذبيحة، مستوى الدهون، صورة الدم والصفات الطبيعية السائل المنوي.

الكلمات الاسترشادية: بوسيدونيا اوشينيكا، الأرانب، النمو، السائل المنوي.

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