

EFFECT OF DIETS CONTAINING SEA-GRASS (*Cymodocea nodosa*) AND TARO HAULMS (*Colocasia esculenta*) ON REPRODUCTIVE PERFORMANCE OF NEW-ZEALAND FEMALE RABBITS UNDER NORTH SINAI CONDITIONS

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ABSTRACT: A total number of 24 New-Zealand White (NZW) doe rabbits aged 5- 6 months and weighed approximately (2.478±0.14) kg was randomly divided into three groups (8/each). The 1st group designated as the control (CON) was fed on the basal diet only. The 2nd group (SGR) was fed the basal diet in which a 10% was replaced with Sea-grass (*Cymodocea nodosa*), and the 3rd group (TAR) was fed the basal diet in which a 10% was replaced with 10% Taro haulms (*Colocasia esculenta*). The experiment continued for three litters.

Results showed that rabbit does fed on sea-grass and taro haulms gave more alive kits per doe kindling compared with those fed the control diet. Weight of kits weaned per doe kindling was highest ($P \leq 0.05$) in the sea-grass group (1.882 kg) followed by taro haulms group (1.760 kg), whereas the control group had the lowest mean (1.439 kg) in that respect. Litter weight from birth to weaning of SGR and TAR treatment groups were significantly higher ($P \leq 0.05$) than those of the CON, whereas SGR and

TAR did not differ ($P > 0.05$).

Stillbirths were lower in the SGR and TAR groups compared with the CON. Feed intake of the SGR and TAR treatments was higher ($P \leq 0.05$) than that of the CON treatment during both pregnancy and lactation periods. Moreover, results showed no significant differences among treatments in body weight changes of doe rabbits at different time periods of their reproductive cycle. Results also showed no significant differences among treatments in litter size, total milk yield and milk conversion rate.

Digestion coefficients of DM, OM, CP, EE, CF and NFE did not differ significantly among treatments.

Conclusively, feeding a diet containing 10% of Sea-grass (*Cymodocea nodosa*) or Taro waste (*Colocasia esculenta*) to New-Zealand White doe rabbits could improve their reproductive performance with no harmful effects compared with feeding the commercial control diet.

It may be recommended to use these residues in the rations of rabbit does.

Key words: Sea-grass, Taro haulms, Reproductive Performance, Sinai.

INTRODUCTION

Compared to other larger domestic species, rabbits have many advantages including high reproductive rates, rapid growth rates, use of non-competitive feeds and simple housing requirements. Due to the high cost of feeding rabbits on traditional feedstuffs, it could be a wise practice to use some untraditional feeds with reasonable nutritional value to reduce the costs of their nutrition.

Sea-grass contains high carbohydrates, proteins, fiber, vitamins and minerals (Abdel-Hady *et al.*, 2007). It contains also high amounts of vitamin A, C and E in the rhizome/root (Jeevitha *et al.*, 2013). Moreover, Kolsi *et al.*, (2018) reported that sea-grasses could be used as natural antioxidants. Vegetable haulms (Taro haulms) are unconventional feed resources and rich sources of nutrients. They can be used in feeding livestock after drying without affecting nutrient utilization, palatability, health or performance of animals (Wadhwa and Bakshi, 2013).

Therefore, this study was carried out to evaluate effects of Sea-grass (*Cymodocea nodosa*) and Taro haulms (*Colocasia esculenta*) on reproductive performance of female NZW rabbits under North Sinai conditions.

MATERIALS AND METHODS

The present study was carried out at the Rabbitry Farm, Department of Animal and Poultry Production, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai, Egypt, during the period from February to June 2019. The objective of this study was to utilize some untraditional feeds such as sea grass and taro haulms available with low prices to evaluate their effects on reproductive performance of NZW rabbit does under North-Sinai conditions.

Plant collection and preparation of the experimental diets:

Sea-grass (*Cymodocea nodosa*) is found in reasonable quantities along the coasts of the Egyptian Mediterranean Sea. It was collected from the area around Bardawil Lake in North Sinai, Egypt and included all parts of the plant. *Colocasia esculenta* is found in abundant quantities in Menofiya Governorate. Dried (*C. esculenta*) which included leaves and petioles (false stems) was provided by Menofiya Governorate. The Sea-grass and Taro haulms were sun-dried until their content of moisture roughly reached 10%, then grounded as powder and samples were taken in plastic bags for chemical analysis.

Experimental animals, management and treatments:

A total number of 24 NZW doe rabbits aged 5-6 months and weighed approximately (2.478 ± 0.138 kg) was randomly divided into three groups (8/each). The 1st group designated as the control (CON) was fed on the basal

diet only. The 2nd group (SGR) was fed the basal diet in which a 10% was replaced with sea-grass (*Cymodocea nodosa*), and the 3rd group (TAR) was fed the basal diet in which a 10% was replaced with taro haulms (*Colocasia esculenta*). All diets were offered to animals in a pelleted form. This experiment aimed at evaluating the effects of these experimental diets on reproductive performance of NZW rabbit does and survival of their kits from birth to weaning. The experiment continued for three litters. All rabbits used in these experiments were healthy and clinically free of external and internal parasites. These animals were raised in efficient hygienic control flat deck batteries with universal specification and accommodated with feeders and drinkers for providing animals with feed pellets and water according to their assigned treatments. The rabbits were housed in a well-ventilated galvanized wire maternity cages. The rabbit does were housed in individual cages of (40 x 55 x 60 cm) with a height of 100 cm from the concrete floor. Each cage was provided with a natal box for kindling and nursing the kits during the suckling period, and was provided with feeders and automatic nipple drinkers. Batteries were arranged in rows in the rearing house in which windows were available for natural ventilation and lighting and provided also with electric fans. A cycle of 16h light: 8h dark was applied using controlled artificial lightening throughout the experimental period. Diets were offered to rabbits *ad libitum* and fresh water was available all the time. All the experimental diets were formulated to fulfill the nutrient requirements for rabbits according to (NRC, 1977). The ingredients of the experimental diets used in the present study is shown in (Table 1). Moreover, the chemical composition of SGR (*C. nodosa*) and TAR (*C. esculanta*) used in this study and chemical analysis of experimental diets are shown in (Table 2).

Reproductive traits of doe rabbits and viability of their kits:

New-Zealand White rabbit does were mated naturally with healthy and examined bucks of the same breed. Mating was done by transferring the female to the male cage and returned back to its own cage after copulation. Pregnancy test was done by palpation at d 12 post-mating (Shetaewi *et al.*, 2000). At kindling time, litters were checked and recorded for their size and weight. Afterwards, litters in the nest were checked each morning to remove the dead offspring. Young rabbits were weaned 28 days after kindling and transferred to other wire cages in groups of two each.

Milk yield of doe rabbits:

Milk yield of doe rabbits were measured every week beginning at d 7 post-kindling and continued until d 21. Milk yield was estimated by the suckling- weigh technique which measures the intake of kits after a fasting period (Mousa and Shetaewi, 1995; Abdel- Samee, 1997; Shetaewi *et al.*, 2001).

Table (1): Ingredients of the experimental diets used in the present study.

Ingredients %	Experimental diets ¹		
	CON	SGR	TAR
Yellow corn, (8.8%).	18	14.5	18
Wheat bran, (14.11%).	29.6	26.5	24.6
Soybean meal, (42.8 %).	15	16.6	15
Alfalfa hay, (14.25 %).	32	27	27
Molasses.	3	3	3
Dicalcium P.	0.35	0.35	0.35
Calcium carbonate (limestone)	0.3	0.3	0.3
Sodium chloride (salt).	1.05	1.05	1.05
Vitamins & Mineral Premix *	0.5	0.5	0.5
Antifungus	0.1	0.1	0.1
Anticoccidiosis	0.1	0.1	0.1
Test material ²	0	10	10
Total	100	100	100

^{1,2}, Experimental diets CON= Control, basal diet *ad lib.*, SGR=10% Sea grass, TAR=10% Taro haulms.

* One kilogram of premix contain: 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 11.79 g, Mn 5 g, Fe 12.5 g, Cu 0.5 g, I 33.3 mg, Se 16.6 mg and Mg 66.7 g.

Table (2): Chemical analysis (%) of Sea-grass (*C. nodosa*), Taro haulms (*C. esculanta*) and the experimental diets of NZW rabbits.

Items	% On DM basis						
	DM	OM	CP	EE	CF	NFE	ASH
Sea-grass (<i>C. nodosa</i>)	89.2	70.29	8.41	0.99	10.12	50.77	29.71
Taro haulms (<i>C. esculanta</i>)*	90.09	83.08	16.41	7.42	14.30	44.95	16.92
Chemical composition of experimental diets given to NZW rabbits							
Diet (1): Control	89.90	92.78	19.02	3.04	14.35	56.37	7.22
Diet (2): SGR (10%)	89.70	90.48	19.15	2.79	13.51	55.03	9.52
Diet (3): TAR (10%)	90.34	91.90	19.10	3.45	13.64	55.71	8.10

Taro haulms (*C. esculanta*)*: Khayyal *et al.*, (2017).

The does were removed from their kits nest at 08:00 on the morning. At 08:00 on the morning of the following day, the kits were weighed and allowed to suckle their dams. Kits body weights were then recorded. The difference in the weight of kits before and after suckling represents the amount of milk

produced by the dam. The total yield for the three weeks of lactation was thus estimated.

Digestibility trials:

Digestibility trials were designed to evaluate differences in digestibility values of different nutrients (CP, EE, CF, NFE, ASH, DM and OM) used throughout the experiments. Four digestibility trials were carried out to determine nutrient digestibility and the nutritive values of the experimental diets. Twelve male rabbits aged 13 months and weighed approximately 2.312 ± 0.14 Kg were chosen randomly from the three treatment groups (3/group). Rabbits were individually housed in metabolic cages (40 × 40 × 50 cm). Feces produced daily were collected in polyethylene bags and stored at -20° C for five consecutive days. The experimental diets were offered daily for a primary period of 10 d and a collection period of 5 d. Fresh water was provided all the time.

A tray covered with plastic sheet was put under each rabbit buck cage and feces that fell on that tray from the rabbit buck was collected every 24 h in the morning during the collection period following submission of the daily feed. Feces from each replicate were then cleaned from scattered feed and fur and dried in an electric oven at 65° C for 48 h, 105° C for 24 h. Excreta of the five collection days were mixed together, weighed, finely grinded and stored in plastic bags. Samples of the feed and the excreta were used for chemical analysis to determine the digestibility coefficients. Diet samples and feces of all rabbit bucks were chemically analyzed for the determinations of percentages dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash (AOAC, 2012).

Nutrient digestibility values of the experimental diets were estimated on DM basis. Values of total digestible nutrients (TDN) and digestible crude protein (DCP) were calculated according to the classic formula described by Cheek *et al.*, (1982), as follows:

$$\text{TDN}\% = \% \text{ DCP} + \% \text{ DCF} + \% \text{ DNFE} + 2.25 (\% \text{ DEE}).$$

$$\% \text{ DCP} = \text{DP} \times \% \text{ CP} / 100.$$

Where: (DCP = Digestible crude protein, DCF= Digestible crude fiber, DNFE= Digestible nitrogen free extract and DEE= Digestible ether extract).

Statistical analyses:

Data were analyzed by least – squares analysis of variance using the General linear model (GLM) procedure of SAS (2004) according to Steel and Torrie (1980).

Body weight of doe rabbits at different time periods (initial, breeding, kindling, post-kindling), feed intake during pregnancy and suckling time periods, milk yield through suckling weeks and through the three consecutive

litters, live litter weight from birth to weaning and kits weights from the 1st wk to the end were analyzed by repeated measures analysis of variance (split-plot; Gill (1978). When a treatment \times time period interaction ($P \leq 0.05$) was detected for any trait, treatment effects within time were tested by one-way analysis of variance.

Data on litter weights at birth, weaning and weight of kits weaned per doe kindled were analyzed by one-way analysis of variance. Whenever F value was significant means were compared using the least significant difference (LSD) test. Categorical data like kindling rate, litter size at birth and stillbirths were analyzed using Chi-Square tests. It tests the hypothesis that the distribution is the same across different groups (Steel and Torrie 1980).

RESULTS AND DISCUSSION

Doe rabbit performance:

1. Body weight and fertility of doe rabbits:

Results presented in Table (3) showed no significant differences ($P > 0.05$) among treatments in body weights at different time intervals of reproductive cycle of doe rabbits. Averages of the body weight at breeding time, body weight pre-kindling and body weight post-kindling were 2.898, 3.200, and 2.830 kg, respectively. Means in the present study lies in the same range obtained by Ibrahim (2016) in NZW doe rabbits under similar conditions in North Sinai. These results presented in Table (3) show that percentage of does that gave birth/does bred (fertility) were generally high (83.3 to 91.7%) compared with those obtained in earlier studies under similar conditions in North Sinai. For instance, Shetaewi (1998) found fertility ranged between 54.5 and 72.7% in Californian (CAL) and NZW doe rabbits and Shetaewi *et al.*, (2000) found better values 78.6 to 85.7 in NZW but still lower than those obtained in the present study. Fertility did not differ significantly ($P > 0.05$) among treatments. However, values tended to be higher in the TAR group (91.7%) followed by SGR (87.5%) and CON (83.3%) groups. The Taro haulms and Sea-grass contain substances or antioxidants that could enhance fertility. Millen *et al.*, (2016) reported that Taro contains high levels of vitamin E. Moreover, SGR contain antioxidants like sulfated polysaccharide which has a role as antioxidants and has potential benefits towards fertility and spermatoc parameters. It was able to protect rats testicular tissues against toxic substances Kolsi *et al.*, (2018). Furthermore, Jeevitha *et al.*, (2013) reported that SGR contains high amounts of vitamin A, C and E in the rhizome/root. Shetaewi (1998) found that antioxidants like vitamin E improved ($P \leq 0.05$) fertility of NZW and CAL rabbits compared with the control (72.7 vs. 54.5).

Table (3): Effects of dietary treatments on weight changes of doe rabbits at different time periods of their reproductive cycle, and effects on their kindling percentages.

Item	Treatment ^{1,2,3}			S.E. ⁴
	CON	SGR	TAR	
BW at breeding time, Kg(1)	2.920	2.89	2.881	0.066
BW pre- kindling time, Kg(2)	3.204	3.23	3.164	0.062
BW post-kindling, Kg	2.867	2.83	2.790	0.060
No. does bred.....(3)	24	24	24	
No. does kindled.(4)	20	21	22	
Kindling % , or fertility (4) x 100/(3)	83.3	87.5	91.7	

¹Treatment, CON, Control, basal diet *ad lib.*, SGR, 10%. Sea-grass, TAR, 10% Taro haulms

²Values are least-squares means. ⁴S.E. = Largest standard error of the means.

³No significant differences were found between treatment means. ($P > 0.05$).

2. Litter size and litter weight of doe rabbits:

Litter size at birth (including stillbirths) did not differ significantly ($P > 0.05$) among treatments but tended to be higher in the SGR and TAR groups (7.52 and 7.32%) compared with the control (6.8%) (Table 4). Prolificacy i.e. no. of kits born alive/doe kindling differ significantly ($P \leq 0.05$) among treatments. Does fed on Sea-grass (SGR) and Taro haulms (TAR) gave more alive kits per doe kindling compared with those fed the control diet (CON), 7.14, 7.09 and 6.15, respectively (Table 4). Prolificacy means obtained in the present study lies in the same range obtained by Shetaewi (1998) in NZW doe rabbits under similar conditions in North Sinai (6.17 to 7.25 g) and higher than those obtained later (5.5 to 6.45 g) in NZW Shetaewi *et al.*, (2000). The increase in prolificacy may be due to the higher content of antioxidants like sulfated polysaccharide (Kolsi *et al.*, 2018, vitamin E Millen *et al.*, 2016) in SGR and TAR treatment groups.

Results of Table (4) also showed that kits livability at birth was higher ($P \leq 0.05$) and stillbirth was lower in the SGR and TAR groups as compared with the control.

Finally, dietary treatments increased ($P \leq 0.05$) total weight of kits born alive (litter birth weight alive) compared with the control, 359.7, 341.9 and 296.6 ± 17 g for SGR, TAR and CON, respectively (Table 4).

Table (4): Effects of dietary treatments on litter size, stillbirths and litter weight.

Items		Treatment ^{1,2}			S.E. ³
		CON	SGR	TAR	
Total of Litter Size	Total no. kits born.	136	158	161	
	No. kits born alive	123	150	156	
	No. kits weaned.	81	121	110	
Stillbirth	Stillbirths % (no. kits born deadx100/total no. kits born.	9.56 ^a	5.06 ^{ab}	3.11 ^b	
Litter Weight	D 1 (Birth), g.	296.6 ^b	359.7 ^a	341.9 ^a	17
	D 7, g.	423.4 ^b	544.3 ^a	484.6 ^{ab}	32
	D 14, g.	669.9 ^b	929.1 ^a	824.8 ^a	62
	D 21, g.	1007.6 ^b	1347.2 ^a	1229.1 ^a	83
	D 28 (Weaning), g.	1439.0 ^b	1881.4 ^a	1760.2 ^a	123

^{a,b} Means in the same row with different superscripts differ ($P \leq 0.05$).

¹Treatment, CON, Control, basal diet *ad lib.*, SGR, 10% Sea-grass, TAR, 10% Taro haulms.

²Values are least-squares mean.

S.E.³ = Largest standard error of the means.

Higher means (553 - 557 g) were obtained earlier by Shetaewi (1998) in NZW and CAL doe rabbits in North Sinai and similar means by Shetaewi *et al.*, (2000) in NZW (335 to 374 g) under the same conditions. The increase in litter weight at birth due to feeding on Sea-grass and Taro haulms may be attributed to the effect of the antioxidant or antimicrobial compounds found in these feeding stuffs. The *C. nodosa* and *C. esculenta* might have properties which could enhance livability of rabbit kits as reported by many workers. Abdel-Hady *et al.*, (2007) found that the ethanolic extract of *C. nodosa* showed antimicrobial activities against all fungi and bacteria. Moreover, Pawar *et al.*, (2018) stated that *C. esculenta* has antimicrobial, antihepatotoxic, and anti-lipid peroxidative properties.

Results presented in Table (4) show live litter weights of doe rabbits from birth to weaning as influenced by dietary treatments. A treatment x week interaction was detected ($P < 0.08$), means were, therefore separated within weeks. As shown in the Table, significant differences between treatments were detected through all the weeks starting from birth to weaning. It is noted that means of SGR and TAR treatment groups were significantly higher ($P \leq 0.05$) than those of the control, whereas SGR and TAR did not differ ($P > 0.05$).

3. *Milk yield of doe rabbits:*

Results presented in Table (5) showed that treatment means during the 1st wk were almost similar. Means of daily milk yield were 87.6, 85.5 and 89.4 g/ d for CON, SGR, TAR treatment groups, respectively. Although feed intake (Table 7) of does during pregnancy was higher in SGR and TAR groups than the CON it was not reflected in increasing their milk yield during the 1st wk of lactation. This could probably be due to the method of estimating milk production of does (weigh-suckle-weigh technique).

The kits during the 1st wk postpartum are too young to completely empty their dams and took advantage of all their milk. During the 2nd wk. the SGR group obtained the highest mean (132.9 g/d) followed by the TAR group (127.2 g/d) and the CON group (116.0 g/d) ($P \leq 0.10$). Differences between the SGR and the CON groups reached significant level ($P \leq 0.05$) at the 3rd wk (165.4 vs. 137.2 g/d, respectively) whereas the TAR group was intermediate (143.5 g/ d). These results go on line with the significant increase ($P \leq 0.05$) in feed intake during lactation of rabbit does of SGR and TAR groups compared with the control (Table 7). It goes in line, too, with higher number of kits reared and weaned per doe kindling in the groups that were supplemented with sea-grass and taro haulms (Table 4). Kolsi *et al.*, (2017) reported that Sea-grass *C. nodosa* could be utilized as a healthy food item for human consumption because it is rich in phenolic or antioxidant compounds.

Litter size or number of kits suckling could affect the amount of milk produced by the doe as mentioned by Lukefahr *et al.*, (1983) and Mahmoud (2013). The SGR group had the highest number of kits per doe (5.9) followed by the TAR group (5.3), whereas the CON had the lowest number (5.04).

Total milk yield across treatments during the three weeks of lactation (Table 5) averaged 2.356 kg. Treatment means in total milk yield did not differ ($P > 0.05$). However, the SGR group tended to be higher (2.407 kg) followed by TAR group (2.332 kg) and the CON group (2.315 kg).

Milk conversion ratio (MCR) of does:

Results showed that the effect of week of lactation on MCR was not significant ($P > 0.05$). The MCR was highest during the 1st week (3.21) and decreased during the 2nd (2.01) and the 3rd (2.39) weeks. The effect of treatment on MCR was not significant ($P > 0.05$), Table (6) showed that the overall means were 2.532, 2.441 and 2.620 \pm 0.14 for CON, SGR and TAR, respectively.

Table (5): Daily milk production (g) and total milk yield (kg/ 21 d) of rabbit does throughout the different weeks of lactation as influenced by dietary treatments.

		Treatment ^{1,2,3}			
Items	Week	CON	SGR	TAR	Overall
Daily milk production (g)	1	87.6 ± 6	85.5 ± 5	89.4 ± 5	87.5 ± 3
	2	116.0 ± 8 ^b	132.9 ± 7 ^a	127.2 ± 7 ^{ab}	126.0 ± 4
	3	137.2 ± 10 ^b	165.4 ± 9 ^a	143.5 ± 9 ^b	149.4 ± 6
Total milk yield (kg)		2.315 ± .148 (17) ⁴	2.407 ± .117 (21)	2.332 ± .114 (22)	2.356 ± .01

^{a,b} Means in the same row with different superscripts differ ($P \leq 0.05$).

¹Treatment, CON, Control, basal diet *ad lib.*, SGR, 10% sea-grass, TAR, 10% Taro haulms

²Values are least-squares means ± standard error

³No significant differences were found between treatment means. ($P > 0.05$).

⁴No. of does kindled.

Table (6): Milk conversion rate of doe rabbits as influenced by dietary treatments.

Items	Treatment ^{1,2,3}			
	CON	SGR	TAR	S.E. ⁴
<i>Milk Conversion Rate (g/g) at*</i>				
1 st week	3.228	2.963	3.435	0.23
2 nd week	2.089	1.945	2.038	0.12
3 rd week	2.205	2.507	2.438	0.15
Overall Means	2.532	2.441	2.620	0.14

¹Treatment groups, CON= Control, basal diet *ad lib.*, SGR=10% Sea grass, TAR=10% Taro haulms. ²Values are least-squares means.

³No significant differences were found between treatment means ($P > 0.10$).

⁴SE= standard error of least-square means.

*As milk intake of litter (g) per litter weight gain (g).

4. Feed intake during pregnancy and lactation:

Results presented in Table (7) show that feed intake of the SGR and TAR treatments was higher ($P \leq 0.05$) than that of the CON treatment during both pregnancy and lactation periods.

Table (7): Feed intake of doe rabbits during pregnancy and lactation periods of the first litter as influenced by dietary treatments.

Feed intake (g.hd ⁻¹ .d ⁻¹)	Treatment ^{1,2,3}			S.E. ⁴	OSL ⁵
	CON	SGR	TAR		
Pregnancy	138.9 ^b (8) ⁶	152.9 ^{ab} (8)	149.1 ^a (8)	5.6	< 0.09
Lactation	179.9 ^b (8)	235.1 ^a (8)	216.1 ^a (8)	12.8	< 0.05
Overall	159.4 ^b (16)	194.0 ^a (16)	182.6 ^a (16)	7.8	< 0.05

^{a,b} Means in the same row with different superscripts differ significantly.

¹Treatment, CON, Control, basal diet *ad lib.*, TAR, 10% Taro haulms, SGR, 10% sea-grass.

²Values are least-squares means. ³A treatment x litter interaction was detected (P<0.07).

⁴S.E. = Largest standard error of the means. ⁵OSL= Observed significance level.

⁶No. of does/treatment group.

The Sea-grass or Taro haulms could probably had improved the palatability of their diets. During pregnancy feed intake was increased by 10% and 7.1% in the SGR and TAR treatment groups compared with the control, respectively. This could be explained on the basis of the number of kits born alive per doe kindling in each treatment (Table 4). During pregnancy feed intake was greater in SGR and TAR treatments (152.9 and 149.1 g.hd⁻¹.d⁻¹, respectively) compared with the CON group (138.9 g.hd⁻¹.d⁻¹).

During lactation, the same trend was noted but with greater increase i.e. by 30% and 20%, respectively for SGR and TAR treatment groups when compared with the CON group. The greater demand of nutrients during lactation especially for multiparous animals like rabbits could justify these differences. The number of kits weaned per doe kindling was higher in SGR and TAR groups than the CON group (121, 110 and 81, respectively, (Table 4). Latu *et al.*, (2017) stated that the nutrient requirements of doe rabbits.

5. Digestibility coefficients and nutritive values:

Results in Table (8) showed no significant differences (P> 0.1) among treatments in digestion coefficients of DM, OM, CP, EE, CF and NFE.

In the same way, the nutritive values of SGR and TAR diets, in terms of total digestible nutrients (TDN), digestible crude protein (DCP) and digestible energy (DE) did not differ significantly among treatments. Feeding rabbits on TAR diet decreased the digestibility coefficients that might be due to the oxalate effect which is considered a major factor contributing to the anti-

Table (8): Digestion coefficients (%) and nutritive value (%) of the experimental diets (LS means \pm SE):

Item	Experimental diet ^{1,2,3}			
	CON	SGR	TAR	\pm SE ⁴
<i>Digestion coefficients, %</i>				
DM	68.84	69.50	67.40	1.6
OM	70.95	71.20	69.57	1.5
CP	78.17	78.28	75.88	1.3
EE	78.69	78.67	80.31	1.1
CF	26.26	30.91	24.97	3.9
NFE	79.48	78.21	78.41	1.1
<i>Nutritive value (%)</i>				
TDN	69.48	67.13	67.80	1.3
DCP	14.87	14.99	14.49	0.3
DE (Kcal/ Kg)*	3052.047	2982.24	3005.54	60.0

¹Treatment, CON, Control, basal diet *ad lib.*, SGR, 10% Sea-grass, TAR, 10% Taro haulms

²Values are least-squares means.

³No significant differences were found between treatment means ($P > .10$).

⁴S.E. = Largest standard error of the means.

* DE (Kcal/ Kg) = $4.36 - 0.0491 \times \text{NDF}\%$, Where, $\text{NDF}\% = 28.924 + 0.657 \times \text{CF}\%$.

palatability effect of Taro waste (Agwunobi *et al.*, 2002). It could be attributed also to the presence of anti-nutritional factors such as tannins, saponins, phytates and hydrocyanide in Taro waste (Abdulrashid and Agwunobi, 2009; Olajide *et al.*, 2011).

Conclusively, the results of present work are promising and opened our eyes towards importance of carrying out further research in this direction in future using different levels of SGR or Tar with higher numbers of animals.

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تأثير علائق محتوية علي عشب البحر (*Cymodocea nodosa*) وعرش القلقاس (*Colocasia esculenta*) علي الأداء التناسلي لإناث الأرانب النيوزيلاندي تحت ظروف شمال سيناء

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تم تقسيم عدد 24 أنثي بالغة من الأرانب النيوزيلاندي الأبيض، تتراوح أعمارها بين 5-6 شهور، بمتوسط وزن حوالي (0.138 ± 2.478) كجم وتوزيعها عشوائيا إلى ثلاث مجموعات (معاملات) (8 لكل مجموعة). تم تغذية المجموعة الأولى والتي تم تحديدها كمجموعة الكنترول (CON) على العليقة الأساسية فقط. والمجموعة الثانية (SGR) تم تغذيتها على العليقة الأساسية بعد ان تم استبدال 10٪ منها بعشب البحر (*Cymodocea nodosa*)، وتم تغذية المجموعة الثالثة (TAR) علي العليقة الأساسية بعد استبدال 10٪ منها بعرش القلقاس (*Colocasia esculenta*). واستمرت التجربة لثلاثة بطون.

وقد أوضحت النتائج أن مجموعة الأرانب التي كانت تتغذى علي عشب البحر أو علي عرش القلقاس أعطت خلفات حية أكثر مقارنة بمجموعة الكنترول. كان وزن البطن عند الفطام هي الأعلى معنويا في مجموعة عشب البحر (1.882 كجم) تليها مجموعة عرش القلقاس (1.760 كجم)، في حين كانت مجموعة الكنترول هي الأقل (1.439 كجم) في هذا الشأن. وكان وزن البطن من الولادة حتى الفطام لمجموعتي عشب البحر وعرش القلقاس هي الأعلى معنويا من المجموعة الكنترول (CON)، بينما لا توجد فروق معنوية بين مجموعتي عشب البحر وعرش القلقاس. معدل النفوق كان أقل في مجموعتي عشب البحر وعرش القلقاس مقارنة بالمجموعة الكنترول ومعدل تناول العلف في مجموعتي عشب البحر وعرش القلقاس كان الأعلى معنويا من مجموعة الكنترول خلال فترتي الحمل والرضاعة. علاوة على ذلك، أظهرت النتائج عدم وجود فروق معنوية بين المعاملات في تغيرات وزن جسم أمهات الأرانب في فترات زمنية مختلفة من الدورة التناسلية. كما أظهرت النتائج أيضا عدم وجود فروق معنوية بين المعاملات في اجمالي حجم البطون ، والإنتاج الكلي للبن ومعدل تحويل اللبن. وفيما يخص معاملات الهضم (DM, OM, CP, EE, CF and NFE) لم توجد فروق ذات دلالة إحصائية بين المعاملات.

التوصية: هذا البحث اعطى نتائج واعدة وجعلنا نفتح اعيننا على أهمية اجراء مزيد من الدراسات في هذا الاتجاه في المستقبل باستعمال مستويات مختلفة من عشب البحر وعرش القلقاس على اعداد اكبر من الحيوانات.