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INFLUENCE OF REPLACEMENT EGYPTIAN TREE WILLOW (*Salix Safsaf*) (LEAVES AND SMALL STEMS) WITH BERSEEM HAY ON SOME REPRODUCTIVE OF DOE RABBITS.

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The present study aimed to investigate the effects of replacing Berseem hay by different levels of Salix Safsaf hay on some reproductive and productive traits of doe rabbits and their offspring's, during the pregnancy and lactation periods. Thirty six New Zealand White (NZW) doe rabbits about 6-7 months old (2.990 - 3.150 kg) were randomly allotted between four experimental groups (9 rabbits in each treatment group).The control group was fed a basal diet ,which including 34 Kg/100 Kg of Berseem hay(T1); the experimental groups received the basal diet replacement with 10.75, 17 and 23.25 Kg/100 Kg Salix Safsaf hay of (34 Kg/100 Kg) Berseem hay diets (T2, T3 and T4), respectively).The experimental period lasted three cycles.

Body weights of does at first week of lactation and at weaning day were (P=0.01 and 0.004) higher in all experimental groupsas compared to control group respectively, while the response of does body weights at initial weight, before and after parturition day were insignificantly affected. As well as gestation length (days) was not significant affected by the replacement of tree willow leaves.

Does rabbits in groupT2 had (P=0.005) higher total feed intake during lactation period in compared with the T1, T3 and T4 group .But, during pregnancy total feed intake was insignificantly affected by replacing Berseem hay by different levels of Salix Safsaf hay.

During lactation period weekly and total milk yield were different in treated groups. The improvement of milk yield at 2nd, 3rd and4th of lactation were (P=0.041, 0.005 and 0.05) increased in group T2 compared to the control group and the other experimental groups.

Average litter weight at weaning and weight gain (P=0.0015 and 0.01) increased for groups T2 and T3 compared to groups T1 and T4,

respectively. The same trends were observed in pre- weaning survival rate (%) from birth to weaning age fed diets including 25 and 50% Salix Safsaf. Replacing Berseem hay in does rabbit diets by Salix Safsaf hay reduced the feeding cost of experimental rabbits.

Keywords: *Salix Safsaf*, does rabbit, reproductive performance, economic efficiency.

Egyptian villages have an ancient thought that rabbit is a productive and fast growing animal that has the possible to produce a substantial amount of meat in a relatively short time. Rabbits are also able to grow and reproduce well from inexpensive forages, agricultural by-product, as well as from commercial premixed diets. Therefore, rabbits can be raised in small -scale. This small-scale system could help numerous household to have meat and also a small but significant cash income source. In ~~the~~ other wise, rabbit diets, roughage sources are included as well, accounting for 35% to 40% of diet volume. Among these sources is berseem hay, which is a dietary source of high cost (Abdel-Kafy *et al.,* 2017). In these circumstances, it is important to search non-traditional feeds in animal feeding having low cost and to raise the product and decreasing the marketing price of animal products. The list of what ingredients can be incorporated into rabbit feed is enormous and growing continuously (Ibrahim, 2000).

The Egyptian willow *(Salix Safsaf)* is a small tree growing in Egypt since pre-historic times. It is generally found in wet ground such as along water-ways. White willow which is also known as the salicin willow has been used for its health benefits for thousands of years (Saller *et al*., 2008). Its branches, being long, thin and pliant, Leaves, seeds, and other parts of the plant were used in medicine. In the Hearst medical papyrus seeds are recommended for cooling the vessels, and for cooling a bone after it has been set (Lise Manniche, 1989). The total N and ME content of willow fodder are about 26.3 g and 10.5 MJ per kg DM, respectively (ThiMui *et al.,* 2005). Willow is moderately digestible and highly palatable for livestock and it is a source of minerals for grazing livestock, including calcium, magnesium, potassium and zinc (Guevara-Escobar, 1999). Willow species synthesize low molecular phenolic glycosides, such as salicin (35 g/kg DM) and/or condensed tannin (CT, 38 g/kg DM) (Pitta *et al.*, 2007). *Salicin* and *salicortin* are the primary salicylates found in white willow (*Salix Safsaf*). They are metabolized by intestinal flora to saligenin Julkunen-Tiitto and Meier (1992), absorbed into the blood stream, and metabolized by the liver to salicylic acid; excretion is primarily through renal (Bissettet, 1994 and Fotsch *et al*., 1989).

Therefore, this study aimed to compare more correctly the single and mixed effects on reproductive performance of does rabbits and their offspring's during the pregnancy and lactation fed on different levels of stem and leave *Salix Safsaf* hay as partial replacement of Berseem hay.

MATERIALS AND METHODS

Experimental work was carried out at El Nobaria Animal Production Research Station, Behera Governorate, Animal Production Research Institute, Egypt. It was started in September, 2017 and lasted for 16 weeks.

A total of thirty six New Zealand White (NZW) does at maturation age (6 – 7 month), weighing 2.990-3.150 kg was equally divided into 4 experimental treatments 9 does in each treatment group. The basal diet was formulated and pelleted to cover the nutrient requirements of rabbits according to De Blas and Wiseman (1998) as shown in (Table 1).

The Egyptian willow trees plants variety (*salix safsaf*) was used for this study. The small stems and leaves part was collected directly in the field, in the region of Nile River in Nobaria, El Behera Governorate Egypt. The collected material was chopped into pieces smaller than 2 cm, using a forage chopper.

The resulting material was then spread over a cement floor, turned over twice a day during three days until complete drying, resulting in hay. It was later baled and stored in a dry and ventilated environment until the time of use, when it was ground for inclusion in the feed.

The experimental groups were classified to four groups as follow: Treatment 1 basal diet contained 34 Kg/100Kg Berseem hay and served as control diet (T1).Treatment 2 basal diet contained 10.75 *Salix Safsaf* + 23.25 Berseem hay Kg/100 Kg (T2).Treatment 3 basal diet contained 17 *Salix Safsaf* + 17 Berseem hay Kg/100 Kg (T3). Treatment 4 basal diet contained 23.75 *Salix safsaf* + 10.75 Berseem hay Kg/100Kg (T4).

Feed and water were provided *ad libitum*, except for does with reproductive problems and outside the lactation period, which received only 120 g daily to avoid overweight. All animals were kept under the same environmental and managerial conditions.

The male: female ration was 1:5. Females were serviced in the morning, with repeated servicing in the late afternoon, always with the same buck as before. Ten days after kindling, does were serviced again, by taking the female to the male’s cage, thereby starting a new reproductive cycle. Whenever the doe did not accept the buck, mating was forced. Females were examined ventrally 10 days after service, and those

Table (1): Composition (Kg/100Kg) of the experimental diets:

Ingredients**	**Experimental diets**			
	T1	**T2**	**T3**	**T4**
Berseem hay	34	23.25	17	10.75
Salix safsaf	–	10.75	17	23.25
Barley grains	15	15	15	15
Plant Concentrate	11.64	11.64	11.64	11.64
Yellow corn	10	10	10	10
Wheat bran	14	14	14	14
Soybean meal 44% CP	10	10	10	10
Molasses	3	3	3	3
Limestone	1.1	1.1	1.1	1.1
Di-Calcum phosphate	0.6	0.6	0.6	0.6
Sodium chloride	0.3	0.3	0.3	0.3
Vit-min premix*	0.3	0.3	0.3	0.3
Lysine	0.02	0.02	0.02	0.02
DL-Methionine	0.04	0.04	0.04	0.04
Total	**100**	**100**	**100**	**100**
Price	**4900**	**4700**	**4500**	**4300**

**Ingredients prices (L.E. per ton) at 2018 were: 3450 barley; 4550 yellow corn; 3050 berseem hay (12%) ; 3100 wheat bran ; 8500 plant Concentrate; 7850 soybean meal (44%) ; 250 limestone ; 25000 premix ; 550000 DL-methionine ; 21000 DL-lysine; 10500 dicalcuim phosphate ; 250 Egyptian *Salix safsaf* ; 500 salt; 1800 cane molasses. - Adding 100 L.E. /ton for pelleting.

* Vit. and Min. mixture: Each kilogram of Vit. and Min. mixture contains: 2000.000 IU Vit. A, 150.000 IU Vita. D, 8.33 g Vit. E, 0.33 g Vit. K, 0.33 g Vit. B1, 1.0 g Vit. B2, 0.33g Vit. B6, 8.33 g Vit.B 5, 1.7 mg Vit. B 1,2 3.33 g Pantothenic acid, 33 mg Biotin, 0.83g Folic acid, 200 g Choline chloride, 11.7 g Zn, 12.5 g Fe, 16.6 mg Se, 16.6 mg Co, 66.7 g Mg and 5 g Mn..

T1= basal diet contained 34 Kg/100Kg Berseem hay.

T2=basal diet contained 10.75 *Salix Safsaf* + 23.25 Berseem hay Kg/100 Kg.

T3=basal diet contained 17 *Salix Safsaf* + 17 Berseem hay Kg/100 Kg.

T4 basal diet contained 23.25 *Salix Safsaf* + 10.75 Berseem hay Kg/100Kg.

that failed were serviced again. The experimental rabbits were allotted in a windowed house. Flat desk cages (60 x 55 x 40 cm) provided with galvanized Nestle lettings for does, feeders and drinker nipples. All kindling kits were remained in the nests with their dams for suckling from birth up to weaning at 28 days of age. For analysis of reproduction-related traits, the following were evaluated: doe weight at service, before parturition day, after parturition day, at first week of lactation and at weaning day; total feed intake during pregnancy, lactation period and within each cycle by does; number and weight of kits born and weaned per doe during the three cycles; litter body weight at weaning per cycle; total number and total body weight of kits at kindling and weaning during the three reproductive cycles. For the weight and number of

kits at kindling, the average weight and number of live-born + stillborn animals were considered. Milk yield was estimated day after day by the difference in doe weight before and after suckling that occurred once every test day. The decrease in mother weight was considered as the milk yield. Litter size, litter weight (g) at birth and weaning were recorded as mass product/doe; pre-weaning survival rate (%) recorded too.

Chemical composition of feed:

Samples of each treatments feed *Salix safsaf* and berseem hay were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), and ash according to the classical (AOAC, 1996) methods. The nutritive value of the experimental diets as DCP and TDN value were calculated according to Cheeke, *et al*. (2013). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were also determined in the experimental rations according to Goering and Van Soest (1970).

Hemicellulose was calculated as the difference between NDF and ADF, while cellulose was calculated as the difference between ADF and ADL. Gross energy (kilo calories per kilogram DM) was calculated according to Blaxter (1968), where, each g of crude protein (CP) = 5.65 kcal, each g of ether extract (EE) = 9.40 kcal and each g crude fiber (CF) and nitrogen- free extract (NFE) = 4.15 kcal. Digestible energy (DE) was calculated according to Fekete and Gippert (1986) using the following equation: DE (kcal/ kg DM) = 4253-32.6 (CF %) - 144.4 (total ash). Non fibrous carbohydrates (NFC) were calculated according to Calsamiglia *et al*. (1995) using the following equation:

$$NFC = 100-\{CP + EE + Ash + NDF\}.$$

The CT of *Salix Safsaf* was determined according to Makkar (2003), salicin and phenolic compounds were determined using the high-performance liquid chromatographic using the procedure of Meier *et al.* (1988).

Relative economic efficiency:

The relative economic efficiency of the experimental diets for the cost of feed required for producing total kg of body weight gain were calculated. The cost of the experimental diets was calculated according to the price of different ingredients prevailing in local market, as well as, the price of testing materials at the time of experimentation. Economic efficiency was calculated as a ratio between the return of weight gain and the cost of consumed feed.

***Statistical Analysis*:**

The experimental design was completely randomized using the General Linear Means of SAS (2001). Measured parameters were analyzed using the following statistical model:

$$Yij = \mu + di + \varepsilon ij \, .$$

Where *yij* is the value measured, μ is the overall mean effect, di is the ith diet effect and *εij* is the random error associated with the jth rabbits assigned to the ith diet. Significant differences of ($P<0.05$) among means were determined using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical analysis and cell wall constituents of the tested materials and the experimental diets are presented in Table 2. The chemical composition of *Salix safsaf* as crude protein, ether extract, ash, gross energy, hemicelluloses, cellulose, dry matter, organic matter, crude fiber, nitrogen-free extract, digestible energy (Kcal/kg DM), non fibrous carbohydrates, acid detergent lignin, acid detergent fiber and neutral detergent fiber contents were in the same range for both Salix Safsaf (leaves and stems) and Berseem hay.

Muklada *et al* (2018) reported that willow fodder composed of 45% leaves and 55% stems, on a DM basis; the weighted content of CP, ME, NDF, Ca, and P were (on a DM basis): 13.6%, 1.8 Mcal, 44.9%, 1.1%, and 0.2%, respectively. Lead, nickel and cadmium were found below the detection threshold in willow fodder and the concentrations of metals did not exceed the recommended ranges in feed. As well as, *Salix safsaf* hay contained an adequate amount of DM, OM, CP, NDF, ADF and DE, which support moderate growth of livestock (McWilliam 2004).

Jo Smith *et al* (2014) reported that leaves + stem of willow tree contained 167 g/kg crude protein on dry matter (DM), while the Neutral detergent fiber, Acid detergent fiber and lignin concentration were 573, 410 and 184 g/Kg dry matter, respectively.

However, the organic matter digestibility determined by *in vitro* pepsin-cellulase method was low (0.405 for leaf + stem) and it might be suitable for other animal groups with lower energy requirements. No condensed tannins (CT) or salicin was detected in Berseem hay but *Salix Safsaf* had a relatively moderate (CT) and high salicin contents, (Table 2). The stems and leaves of *Salix safsaf* contained substantial concentrations of secondary metabolites, including lignin, CT, salicin and other phenolic compounds. In this connect Muklada *et al* (2018) they analyzed Leaf and stem of willow tree and found it contained condensed tannins (6.9 and 4.5%), respectively, while, it contains total phenolic compound (9.4 and 4.8%). However, McWilliam *et al* (2005) said that willow contained high concentrations of condensed tannin (CT; 52 g/kg) and total phenolic glycosides (34 g/kg.

Table (2): Chemical analysis and cell wall constituents (%) of the tested materials and the experimental diets.

Items	Tested materials		Experimental diets			
	Berseem hay	*Salix safsaf* (stems + leaf)	T1	T2	T3	T4
Chemical analysis (%)						
Dry matter	91.5	90.47	90.5	91.22	91.07	91.23
Chemical analysis on DM basis						
Organic matter (OM)	79.7	76.7	82.8	83.4	83.0	82.3
Crude protein (CP)	11.2	12.3	17.1	17.2	17.5	17.6
Crude fiber (CF)	25.9	22.9	13.0	12.9	13.1	13.3
Ether extract (EE)	1.7	3.3	2.9	3.0	3.0	3.0
Nitrogen-free extract (NFE)	41.0	38.3	49.8	50.3	49.4	48.4
Ash	12.0	13.8	8.7	8.6	8.6	8.8
Gross energy (Kcal/kg DM)[1]	3564	3537	3847	3876	3863	3835
Digestible energy (Kcal/kg DM)[2]	1680	1516	2572	2592	2580	2549
Non fibrous carbohydrates (NFC)[3]	29.2	26.8	33.8	33.8	33.4	33.0
Cell wall constituents						
Neutral detergent fiber (NDF)	45.9	43.9	37.5	37.4	37.5	37.7
Acid detergent fiber (ADF)	40.9	38.7	22.2	22.2	22.3	22.5
Acid detergent lignin (ADL)	27.3	22.7	10.0	9.7	9.4	9.1
Hemicellulose	5.0	5.3	15.2	15.2	15.2	15.1
Cellulose	13.6	15.9	12.3	12.5	13.0	13.4
Phenolic compounds	ND	8.32	ND	ND	ND	ND
Condensed tannins	ND	3.7	ND	ND	ND	ND
Salicin (g/kg dry matter)	ND	1.2	ND	ND	ND	ND

1Gross energy (kilo calories per kilogram DM) was calculated according to Blaxter (1968), where, each g of crude protein (CP) = 5.65 kcal, each g of ether extract (EE) = 9.40 kcal and each g crude fiber (CF) and nitrogen-free extract (NFE) = 4.15 kcal. 2Digestible energy (DE) was calculated according to Fekete and Gippert (1986) using the following equation: DE (kcal/ kg DM) = 4253-32.6 (CF %) -144.4 (total ash). 3 Non fibrous carbohydrates (NFC), calculated according to Calsamiglia *et al.* (1995) using the following equation: NFC = 100-{CP + EE + Ash + NDF}. Hemicellulose = NDF-ADF. Cellulose = ADF-ADL. ND: Not determines.

T1= Basal diet contained 34 Kg/100Kg Berseem hay. T2=Basal diet contained 10.75 *Salix safsaf* + 23.25 Berseem hay Kg/100 Kg.

T3=Basal diet contained 17 *Salix safsaf* + 17 Berseem hay Kg/100Kg. T4: Basal diet contained 23.25 *Salix safsaf* + 10.75 Berseem hay Kg/100Kg.

The experimental diets were iso caloric and iso nitrogenous. Protein contents for the four tested rations (T_1–T_4) ranged from 17.1 to 17.6%, the digestible energy values ranged from2549 to 2592 (kcal/ kg DM) for all diets. All parameters determined of chemical analysis were similar for the different experimental diets regardless the phytochemicals content of used *Salix safsaf*.

Body weight of does

Body weights of doe rabbits as affected by replacement *Salix Safsaf* with berseem hay were displayed in Table 2. Initial doe weight of the animals, ranging between 2990 and 3150 g. Results show that average doe body weight during pregnancy and lactation not significantly affected by replacement *Salix Safsaf* with berseem hay, except for lactation day and at weaning day, respectively. Improved body weight (P=0.01and 0.004) at first week of lactation and at weaning day were detected due to the dietary stems and leaves of *Salix Safsaf* as compared with control group, respectively. This improvement back to the increase feed intake in T2, T3 and T4 as compared with T1 (control), as well as heavy does were heavier as a consequence of a higher feed intake or a higher growth potential, but that over fattening had not occurred (Rommers *et al* 2002).

Body weight after parturition (day) followed a downward trend when compared with the initial body weight of all the experimental treatment. This reduction in body weight back to rabbit does are susceptible to a severe energy deficit during first lactation (Xiccato, 1996), resulting in decreased reproductive performance. Average gestation length for all the animals also, falls within 29.7-30.1days with no significant difference across the treatments. The results are in agreement with the findings of (Saha *et al.,* 2013).

Total feed intake of does

In this concern, Basyony *et al* (2018) found that grower rabbits fed diets including different levels 25, 50 and 75% of stems and leaves of *Salix safsaf* hay with berseem hay feed intake of (DM, CP and DE) was insignificant (P > 0.05) decreased when compared with control diets. Meanwhile, Muklada *et al* (2018) said that goats fed on the willow fodder consumed less DM than the goats fed on clover hay (1760 and 2100 g/d, (P<0.01), respectively). However, increased feed intake with low *Salix Safsaf* substitution may have been due to positive impacts of low dose of plant secondary metabolites on cecal fermentation, whereas the high *Salix Safsaf* dose high plant secondary metabolites substitution with antimicrobial activity decreased microbial activity and diet ferment ability, which negatively affected dry matter intake (Jiménez-Peralta *et al*., 2011; Salem *et al.,* 2011). Replacement of low doses of *salix safsaf* likely encouraged some cecal bacterial species to metabolize

phenolic compounds (Chen *et al.,* 1988; Salem *et al.,* 2010), and may act as catalysts for fiber digestion by increasing access of fibrolytic bacteria to cell wall polysaccharides in the diet. This action will lead to increased rates of disappearance in the cecum, with increased rates of passage and feed intake as a result (Conrad, 1966). Also, differences in feed intake observed by various researchers could be linked to differences in feed types, feed ingredients used, litter size, as well as the stage of maturity of forages used in feeding the rabbit does. Rabbit does moderate their nutrient intake to provide for their fetuses and for mammary glands development required during lactation (Iyeghe Erakpotobor *et al*., 2006). Another aspect related to the lower intake of the half-simplified diet could be the presence of polyphenols in the *Salix Safsaf* leaves (8.32%), which may affect the palatability of the diet especially during the pregnancy periods.

Milk yields of does

Milk production (g) of does during lactation periods were significantly affected by substitution *Salix Safsaf* to berseem hay as compared to the control (Table 3). Milk production (g) of does during lactation periods were significantly affected does rabbit fed diet T2 constantly had a higher caused milk yield in comparison with T1, T3 and T4. Also, doe rabbits feed in T2 caused an increase significantly (P=0.05**)** milk yield, during lactation periods at 2^{nd}, 3^{rd} and 4^{th} week when compared to control group. This could be due to that synergistic effect between *Salix Safsaf* and berseem to improved secretions metabolic hormones which altered in lactating does to favor mobilization of body reserves to support milk production.

Besides, Salem *et al* (2016) showed that supplementation of 0, 150 and 300 mL of Salix babylonica (SB) extract mixed into the cow diets cows caused increased ($P \leq 0.05$) milk production. Another important factor affecting milk output is the increased litter size. During the lactation, milk output is higher when the litter size is larger (McNitt and Lukefahr, 1990). As well as increasing food consumption during lactation period may be due to the increase of both doe body weight and milk production during the lactation as shown in (Table 3). Through that study we conclude that body weight of dams had a positive effect on the milk production.

The obtained positive correlation between milk yield and dam body weight may be attributed to the increase of the mammary gland size by increasing the dam body weight hence the increase in milk production. The present results were agreed with that obtained by MacNitt and Lukefahr (1990) and Yamani *et al.,* (1992) who reported a significant correlation between milk yield and doe weight at kindling.

Table 3: Effect of dietary treatments on live body weight and feed intake of does during pregnancy and lactation periods.

Items	Experimental treatment				SEM	*P*-value
	T1	T2	T3	T4		
Body weight(g):						
Initial weight of doe	2990	3070	3150	3025	108.47	0.469
Before parturition day	3140	3300	3325	3295	61.01	0.25
After parturition day	2890	2905	2850	2800	55.69	0.321
At first week of lactation	2800^{b}	3000^{a}	3071^{a}	3000^{a}	57.81	0.01
	2915^{b}	3100^{a}	3130^{a}	3075^{a}	86.47	0.004
At weaning day	30.1	30.1	29.7	30	0.97	0.224
Gestation length (days)						
Total feed intake						
During pregnancy	3775	3710	3700	3690	99.91	0.55
During Lactation	4090^{c}	4630^{a}	4510^{ab}	4210^{b}	130.24	0.005
Mill yield (g/ week):						
1^{st}	81.22	82.17	83.11	80.36	8.01	0.215
2^{nd}	99.11^{b}	112.65^{a}	106.04^{ab}	89.69^{c}	21.01	0.041
3^{rd}	119.40^{b}	135.30^{a}	123.96^{ab}	97.93^{c}	13.10	0.001
4^{th}	91.48^{b}	115.02^{a}	110.36^{ab}	79.23^{c}	16.7	0.05

a- c, Means within a row not sharing similar superscripts are significantly different.
T1= basal diet contained 34 Kg/100Kg Berseem hay.
T2=basal diet contained 10.75 *Salix safsaf* + 23.25 Berseem hay Kg/100 Kg.
T3=basal diet contained 17 *Salix Safsaf* + 17 Berseem hay Kg/100 Kg.
T4 basal diet contained 23.25 *Salix Safsaf* + 10.75 Berseem hay Kg/100Kg.

Other studies Lukefahr *et al* (1983) and Ekambaram *et al* (2006) found no significant relationship between milk yield and doe weight at kindling. Does rabbits fed on the 75% S*alixSsafsaf* instead of berseem hay diet ingested less feed. This lower amount was insufficient to provide the necessary nutrients to maintain the females while gestating and producing milk. Consequently, there was a higher kit mortality rate ($P \geq 0.05$) and lower weight at kindling compared with kits from does fed the reference feed (Table 4). Almost no published reports are available in the literature on the effect of *Salix Safsaf* inclusion in diet of rabbits on milk production; therefore, the present results could not be compared. In parallel to our results Etima and Oguike (2014) found that doe rabbits fed mixed forages (*Centrosema pubescens, Ipomea batatas leaves and Panicum maximum*) plus concentrate diet (500 gram of forage per kilogram body weight) until after kindling, made a milk yield significantly ($P < 0.05$) higher than control rabbits fed on *Aspilia Africana* alone plus concentrated diet. These findings particularly for T2

showed that maximum milk production could be obtained using forages that have both lactopoietic and lactogenic properties such as *Salix Safsaf.*

Litter performances of does

Performance and survival rate (%) of litters as affected by studied replacement *Salix Safsaf* to berseem hay are displayed in Table 4. Results show that litter size at birth and at weaning was not significantly affected by studied incorporation *Salix Safsaf* instead of berseem hay.

In this connect, Alemede *et al.*(2014), who reported that litter size at weaning of (5.2) in a study to evaluate the effects of feeding does with varying levels of *Moringa* leaves meal on reproduction. Also, improved litter weight (P=0.04) at weaning was detected due to the S*alix Safsaf* tried, especially feeding diets in T2 and T3. Thus, litter weight at this time would expect to be a useful index for lactation performance (Knight *et al*., 1989). Also, the increase in their weight gain may be due to the increase in milk yield (Table 3).

Average litter weight gain followed the same pattern as the litter weight at weaning with T2 (25%) and T3 (50%) dietary treatments groups recording the highest litter weight gain. However, average litter weight gain in group of T4 (75%) was better than control group T1.

Table 4: Effect of dietary treatments on performance of Litter at birth and weaning of does during the three reproductive cycles.

Treatment groups	**Litter size**		**Average litter weight (g)**		**Average litter Weight gain (g)**	**Pre-weaning survival rate, (%)**
	Birth	**Weaning**	**Birth**	**Weaning**		
T1	7.31	6.83	296	2879^{b}	2583^{c}	94.6^{b}
T2	6.98	6.90	314	3381^{a}	3067^{a}	100^{a}
T3	7.11	7.05	313	3342^{a}	3029^{a}	100^{a}
T4	7.21	7.15	304	3080^{b}	2776^{b}	91.2^{c}
SEM	**0.52**	**0.26**	**76.31**	**58.34**	**41.3**	**23.11**
P-value	**0.756**	**0.621**	**0.511**	**0.04**	**0.0015**	**0.01**

a- c, Means within a row not sharing similar superscripts are significantly different.

T1= basal diet contained 34 Kg/100Kg Berseem hay.

T2=basal diet contained 10.75 *Salix safsaf* + 23.25 Berseem hay Kg/100 Kg.

T3=basal diet contained 17 *Salix safsaf* + 17 Berseem hay Kg/100 Kg.

T4 basal diet contained 23.25 *Salix safsaf* + 10.75 Berseem hay Kg/100Kg.

Means of pre- weaning survival rate (%) from birth to weaning age in the treatments groups were 94.6, 100, 100 and 95.2 %, respectively (Table 4). The differences between the treatments were significant (P=0.01).

Economic evaluation:

Average total body weight gain to weaned rabbits and feeding cost are generally among the most important factors involved in achievement of maximum efficiency values of meat production. The relative economic efficiency (REE) of the different formulated diets as affected by different treatments is shown in Table 5.

It should be pointed that the relative economic efficiency values were calculated according to the prevailing cost price of average weight gain of kits/ does rabbits.

Table (5): Economical efficiency as affected by dietary treatments to weaned rabbits.

Items	Treatment groups			
	T1	**T2**	**T3**	**T4**
Average litter weight gain (Kg)	2.58	3.07	3.04	2.78
Price of 1kg body weight	38	38	38	38
Selling price/average weight gain, (g) (LE) (A)	98.04	116.66	115.52	105.64
Average total feed intake/ doe rabbit (Kg)	7.87	8.34	8.21	7.90
Price/kg feed(LE)	4.9	4.7	4.5	4.3
Total feed cost/ doe rabbit (LE) (B)	38.56	39.2	36.95	33.97
Net revenue(LE)[1]	59.48	77.46	78.57	71.67
Economic efficiency[2]	1.54	1.98	2.13	2.11
Relative Econ. Eff.[3]	100	129	138	137

Ingredients prices (L.E. per ton) at 2018 were: 3400 barley; 4050 yellow corn; 2950 berseem hay (12%) ; 3000 wheat bran ; 7850 soybean meal (44%) ; 250 limestone ; 25000 premix ; 550000 DL-methionine ; 21000 DL-lysine; 10500 di-calcuim phosphate ; 500 Bean Straw; 500 salt; 1800 cane molasses. - Adding 100 L.E. /ton for pelleting.

(1) Net revenue = A – B.

(2) Economic efficiency = (A-B/B).

(3) Relative Economic Efficiency= Economic efficiency of treatments other than the control/ Economic efficiency of the control group.

Results indicated that using *Salix Safsaf* as replacement of Berseem hay in doe rabbit diets improved slightly the net revenue and reduced the total feed cost.

The lowest total feed cost / doe rabbit (33.97 LE) was observed with doe rabbits fed the diet T4. Data showed that 50% *Salix Safsaf* hay

in Berseem hay diet to doe rabbit gave the best economic efficiency (2.13). The results indicated that 10.75, 17 and 23.25 Kg/100 Kg *Salix Safsaf* hay as a partial replacement of Berseem hay improved the REE of diets by 129, 138 and 137%, respectively, when compared with the doe rabbits fed T1. While, the economic efficiency values were raised with S*alix Safsaf* hay in Berseem hay diets 28.6, 38.3 and 37 %, respectively, compared with rabbits fed the control diets. No available feasibility study about the cost of diets when *Safsaf* hay is partial replaced Berseem hay. In parallel to our results Oliveira *et al* (2011) and Alemede *et al* (2014) reported that feed cost per kg of body weight fed on diet containing 79.83% cassava byproduct had been reduced by 23.63% compared with the control diet.

Conclusion, *Salix Safsaf* hay can be considered as good source of principle compounds as Berseem hay. The results of the study revealed that all tested levels of *Salix Safsaf* hay were useful as a natural feed substitution with Berseem hay to maintain productive and could reduce the negative effects of feed cost for does rabbits.

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أثر استخدام الاوراق والسيقان الصغيره لشجر الصفصاف المصرى (*Salix safsafs*) فى علائق امهات الارانب على الأداء التناسلى.

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أجريت هذة التجربة لدراسة تأثير إستخدام 25 و50 و75% من اوراق وسيقان شجر الصفصاف إحلال من دريس البرسيم على الأداء التناسلى لامهات الارانب. تم تقسيم 36 انثى أرنب نيوزيلاندى أبيض 6-7 شهور عشوائيا بمتوسط وزن2.992-3.150 كيلو جرام الى 4 مجموعات (9 أنثى أرانب) ، واستمرت التجربة لمدة ثلاث دورات، وكانت العلائق التجريبية كالتالى: العليقة الأولى وهى عليقة كنترول ،عليقة الثانية والثالثة والرابعة تحتوى على 25 و50 و75 % من اوراق وسيقان شجر الصفصاف محل الدريس على التوالى.

يمكن تلخيص النتائج كما بلى:

وزن الجسم لامهات الارانب في الأسبوع الأول من الرضاعة وعند يوم الفطام كانت أعلى (P=0.01 and 0.004) في جميع المعاملات التجريبيه مقارنة بمجموعة المقارنه ، في حين كان وزن الجسم عند بداية التجربه وقبل وبعد يوم الولادة وكذلك طول فترة الحمل (باليوم) لم تكن هناك اختلافات معنويه بين المعاملات التجريبيه.

استهلاك العلف لامهات الارانب خلال فترة الرضاعه كان افضل (P=0.005) فى المجموعه الثانيه عن مجموعة المقارنه وايضا باقى المعاملات التجريبيه فى حين لم يظهر استهلاك العلف للأمهات اى فروق جوهرية بين المجموعات التجريبية خلال فترة االعشار.

انتاج اللبن خلال فترة الرضاعه لامهات الارانب فى الاسبوع الثانى والثالث والرابع كان افضل (P= 0.041, 0.005 and 0.05) على التوالى للمعامله الثانيه عن المجموعه المقارنه وباقى المجاميع التجريبيه.

متوسط وزن الخلفات عند الفطام والزياده فى وزن الجسم للخلفات المفطومه لامهات الارانب فى المعامله الثانيه والثالثه كانت افضل (P= 0.0015 and 0.01) عن المجموعه المقارنه والمجموعه الرابعه التجريبيه.

من ناحية اخرى ادت هذة النسب 25 و50 و75% من اوراق وسيقان شجر الصفصاف محل الدريس الى تحسن الكفاءة الاقتصادية لاعلاف امهات الارانب.

التوصية: يمكن التوصية ان اوراق وسيقان شجر الصفصاف محل دريس البرسيم فى علائق امهات الأرانب حتى مستوى 75% يحسن من الأداء الأنتاجى والكفاءة الأقتصادية لأنتاج الأرانب.