EFFECT OF DIETS CONTAINING DIFFERENT LEVELS OF SUN DRIED *MORINGA OLEIFERA* LEAVES ON MILK YIELD, CHEMICAL COMPOSITION AND REPRODUCTIVE PERFORMANCE OF RABBIT DOES

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SUMMARY

Sixty Virgin New Zealand White Rabbit Does(VNZWRD) during three consecutive reproductive cycles, with average initial age of six months and weighing 2.98 kg and servicing for the first time at seven months were allotted to four experimental diets. Sun dried *Moringa oleifera* leaves replaced soybean meal by 0% ($G_{0\%}$),25%($G_{25\%}$) ,50%($G_{50\%}$) and 75% ($G_{75\%}$) .Results showed non significant differences in the total feed intake(FI) and average body weight does on the different groups. The $G_{75\%}$does had the highest FI (183.20 g/day) followed by $G_{25\%}$ (173.80 g/day) , $G_{50\%}$ (169.80g/day) whereas $G_{0\%}$ does had the lowest (168.40 g/day).There were significant differences in the litter size at birth (LSB) of does on the different groups .The $G_{75\%}$ does had the highest litter size at birth of(7.866) followed by $G_{50\%}$ (7.622) and $G_{25\%}$(7.377),while $G_{0\%}$ does had the lowest (6.422).Both litter weight at birth and litter weight at weaning were highest in $G_{75\%}$ (392.44 and 3162.73g), respectively with significant ($p<0.01$) different in litter weight at weaning across all levels of SDMOL. There were significant differences ($p<0.01$) in average milk yield during 21 across. Milk yield was higher in $G_{75\%}$ (2095.02g) followed by $G_{50\%}$(2048.82g) , $G_{25\%}$(2019.33g),while $G_{0\%}$ does had the lowest (1957.22g) ($p<0.01$).It can be concluded that sun dried *Moringa oleifera* leaves can be used as additives without adverse effect on the reproductive performance of and milk yield of does rabbits.

***Keywords**: sun dried Moringa oleifera leaves, Virgin doe's rabbits, Reproductive performance and Milk yield.*

NTRODUCTION

Moringa oleifera is known as "the mother's best friend" due to its uses to increase nursing mothers' milk production (Valdivié, *et al*.,2017 that may be attributed to Cu and Zn, which are essential in increasing the rate of pregnant female milk production (Valkovic, 1975). Moringa leaves have high contribution toward the increasing of growth and organism level of health mainly to increase rural community health, supplement for pregnant women and to recover type 2 diabetes (Markus *et al*.,2017).Moringa leaves are sometimes used mostly to tackle problems encountered primarily related to the adequacy of protein. The galactogogue effect of moringa leaves meals increase milk production as a result of increasing of prolactin secretion (Markus *et al*. (2017). Leaves are very nutritious and rich in protein,essential amino acids, vitamins A, B and C, and minerals. They are highly recommended for pregnant and nursing mothers as well as young children (FAO, 2014). They are generally cooked (boiled, pan-fried) and eaten like spinach or put in soups and sauces. Moringa leaves are also eaten as a salad or dried and ground to make a very nutritious leaf powder. Moringa leaf powder is used to aid the restoration of infants suffering from malnutrition. Many trials have assessed the nutritive value of moringa leaf meal, for growing rabbits, as a potential replacement for soybean meal (Nuhu, 2010; Ewuola *et al*., 2012a; Odetola *et al*., 2012; Owen *et al*., 2013), ground nut cake (Adeniji and lawa., 2012; Alemede *et al*., 2014), wheat offal (Vantsawa and Dramola., 2014), or maize bran plus soybean meal (Abu *et al*.,2013). Inclusion rates in such diets ranged between 10 and 15%. These trials generally

concluded that moringa leaf meal can be used safely in rabbit feeding, with no reduction in growth rate, feed efficiency, and slaughter yield or blood parameters. However, moringa leaf meal has been linked to a slight but significant reduction of serum glucose and serum cholesterol concentration (Rajeshwari *et al*., 2008; Ewuola *et al*., 2012b). In some trials, moringa leaf meal was included successfully at 30% (Dahouda *et al*., 2013), and up to 40% of the diet (Safwat *et al*., 2014b). Ayodele *et al*., 2014 found that substitution for soybean meal protein by Moringa leaf meal improved performance breeding does rabbit.The present work was conducted to study the effect of replacing different levels of soybean meal by moringa leaves on productive and reproductive performance of rabbit does.

MATERIALS AND METHODS

Experimental site and formulated diets

The present experiment was carried out at the private farm of Kaluobia governorate, Egypt during January (2017). The chemical analysis was conducted at the laboratories of the Faculty of Agriculture and Natural Resources - Aswan University. The objective of this experiment was to study the effect of replacing 25,50 and 75% of soybean meal in does rabbit diets by sun dried *Moringa oleifera* leaves powder (SDMOLP).

Animals

Sixty Virgin New Zealand White Rabbit Does (VNZWRD) were used, during three consecutive reproductive cycles, with average initial age of six months and weighing 2.98 kg and servicing for the first time at seven months.

Rabbit does were housed individually in galvanized wire cages and were randomly assigned to 4 experimental groups (fifteen per each group), on the basis of live body weight and age .Each experimental group was fed ad libitum on one of the four following diets .

$G_{0\%}$: pelleted complete diet formulated in the farm where the main source of protein was soy bean meal and served as control group.

$G_{25\%:}$ pelleted complete diet where 25% of soy bean meal was replaced by SDMOLP.

$G_{50\%:}$ pelleted complete diet where 50% of soy bean meal was replaced by SDMOLP.

$G_{75\%}$: pelleted complete diet where 75% of soy bean meal were replaced by SDMOLP .

Does were fed rations ad libitum intake and clean water was available for all rabbits by nipple drinker all time. The experimental period lasted for 96 days.

All Does were weighed at the end of the every one reproductive cycle, using digital scale, for monitoring of weight change and feed conversion. Initial body weights were recorded. Changing does weigh calculated at the end of the every one reproductive cycle. Average daily feed intake (ADFI) by individual does was estimated by summing the monthly intake and dividing by the number of days of the month. Ingredients and chemical composition of the experimental diets are reported in Table (1). Feed offered and feed refused were recorded daily.

Time service:

Prior to first servicing, does were allotted in four groups and fed the experimental diets during 30 days. Females were serviced in the morning by taking the females to the male's cycling cage. On the 2nd day of kindling, does were serviced again. Thereby starting a new reproductive cycle. Does were tested ventrally two weeks after mating, and those that negative were remitting again. Four days before Kindling, nest boxes were placed in front does cages, where they remained until kits were 26 days old .During the time that nest boxes remained in front does cages .At the three days after kindling, daily inspections were mad to maintain adequate conditions during the physiological stage. The litters were weaned at 26 day in the three parities.

Measurements, Sample collection for laboratory analyses

Rabbit milk yield and composition:

Milk production was estimated daily from 1 to 21 day of age of the litter using the weight –suckle-weigh

methods (Lukefahr *et al.*, 1983). Milk samples were collected (10 ml) from five does each group on day 21st using 'home made air vacuum pump' from most nipples of mammary gland. Milk samples were analyzed for fat, protein and lactose by infrared spectrophotometry (Foos120 Milko-Scan,Foss Q3183 electric, Hiller0d, Denemark).

Table (1): Ingredients and chemical composition of the experimental rations (DM %).

Item	Levels SDMOL (% of dietary DM)			
Ingredients (DM %)	$^{1}G_{0\%}$	$^{2}G_{25\%}$	$^{3}G_{50\%}$	$^{4}G_{75\%}$
Alfalfa hay	30	30	30	30
yellow corn	11.2	11.2	11.2	11.2
Barley	20	20	20	20
Soybean meal	12	9	6	3
SDMOLP	0	3	6	9
Wheat bran	25	25	25	25
Limestone	0.7	0.7	0.7	0.7
Permix	0.3	0.3	0.3	0.3
Salt food	0.3	0.3	0.3	0.3
Dicalcium Phosphate	0.5	0.5	0.5	0.5
Total	100	100	100	100
Cost1kg diets L.E	4.00	5.68	7.36	9.04
Calculated diets composition, %				
CP%	17.286	16.794	16.302	15.81
EE%	4.463	4.685	4.907	5.129
CF%	12.551	12.828	13.105	13.383

SDMOLP = Sun Dried Moringa oleifera Leaves powder.
[1] = control diet , [2] = 25% SDMOLP ,[3]= 50%SDMOLP and [4]=75%SDMOLP

Feed conversion ratio

This was calculated according to lyayi *et al*.,(2003) as following:

Feed conversion ratio =FI (g)/LWW (g).

Where: FI (g) =Feed intake (g)

LWW (g) =Litter weight weaning (g)

Statistical Analysis

All data were analysed according to complete randomized design SAS using the PROC MIXED procedure of SAS (2004). The statistical model was: $Y_{ij} = \mu + G_i + C_j + E_{ij}$, in which Y_{ij} is the dependent variable, μ is the overall mean, G_i is the fixed effect of groups (i = 1, 2,3 and 4), C_j is the random effect of animal within group, and E_{ij} is the residual error. Group means were computed with the LSMEANS option.

RESULTS AND DISCUSSION

Chemical composition

As shown in Table(2), chemical analysis of SDMOL compared with SBM revealed that CP was (27.20 vs 43.60),CF (11.50 vs 6.61),EE(7.40 vs 2.55) ,NFE (46.91 vs36.64) and ash (9.60 vs 7.75). Zarkadas *et al*., (1995) observed that the *Moringa oleifera* has high biological value protein contain the most essential amino acids in additional it has higher concentration than the one recommended by FAO and WHO(1991) mentioned in the feed reference that is soybeans. Aye and Adegun(2013) showed that *Moringa oleifera* leaves meal contains DM(93.63), ash(7.96), CP(22.23),CF(6.77),EE(6.41) and NFE(40.28).Also, Ojo and Abdurahman(2017) found that *Moringa oleifera* contained DM(91.78),CP(28.43),EE (6.40) ,CF(9.15),total ash(9.09) and NFE(46.93).These variations in chemical composition of *Moringa oleifera* may attributed to many factors (location and time of harvesting of plants).

Table (2) :Chemical Composition of soybean meal and sun dried Morina Oleifera leaves on DM basis.

Item	DM%	OM%	CP%	EE%	CF%	NFE%	Ash%
Soybean meal	89.4	92.25	43.60	2.55	6.61	39.49	7.75
Sun dried Moringa Oleifera	93.01	90.40	27.2	7.40	11.50	44.3	9.60

DM = dry matter; OM = organic matter; CP = crude protein; CF = crude fiber; EE = ether extract; NFE = nitrogen free extract.

***Feed intake* and body weight changes**

Data of Table (3) showed that feed intake of does fed on different levels of SDMOL was non significant more than does fed the control diet. The does fed the $G_{75\%}$ diet showed the greatest feed intake (183.20 g/day) compared the $G_{0\%}$ diet (168.40 g/day).On the other hand feed intake was increase gradually in all treatments by increase in doe weight during the three kindling (from the first Kindling to the third kindling) than that of does receiving the $G_{0\%}$ diet.

Table (3): Effect of SDMOL on productive performance.

Item	Levels SDMOL			
1st Parturition	$G_{0\%}$	$G_{25\%}$	$G_{50\%}$	$G_{75\%}$
WDI(kg)	3.0	2.96	3.0	2.96
WDK_1(kg)	3.22	3.10	3.18	3.24
CBD_1(kg)	0.22	0.14	0.18	0.28
$FIDD_1$(g/day)	168.4	173.8	169.8	183.2
2nd Parturition				
WDK_2(kg)	3.34	3.42	3.50	3.64
CBD_2 (kg)	0.16	0.32	0.40	0.40
$FIDD_2$(g/day)	224.2	219.80	226.40	230.60
3rd Parturition				
WDK_3(kg)	3.30	3.70	3.68	3.76
CBD_3(kg)	0.080	0.28	0.22	0.18
$FIDD_3$(g/day)	226.4	258.60	248.2	258.0

Where:
WDI= Weight does initial *WDK_1=Weight does 1st kindling* *WDK_2=Weight does 2nd kindling* *WDK_3=Weight does 3rd kindling* *CBD_1=Change body does 1st kindling* *CBD_2=Change body does 2nd kindling* *CBD_3=Change body does 3rd kindling* *$FIDD_1$ =Feed intake daily does 1st kindling* *$FIDD_2$ =Feed intake daily does 2nd kindling* *$FIDD_3$ =Feed intake daily does 3rd kindling*

Data of Table (3) showed non significant difference in initial body weight of does (in the mating weights that, ranged between 2.96 and 3.0 kg. Changes of does body weight during the first weaning parity , second weaning parity and third weaning parity did not differ between the different levels of SDMOL. That means no negative effect of moringa on body weight changes of rabbit does.

Litter size

Data in Table(4) showed that average litter size at birth ,litter size a live, litter weight at birth and litter weight at weaning for the different four treatments studied as affected by treatment varied from 7.866 vs 6.422; 6.711 vs4.844; 392.44 vs 250.98 and 3162.73 vs2678.78 for $G_{75\%}$ vs $G_{0\%}$ respectively. In addition,$G_{0\%}$ gave significantly (P> 0.01)smallest litter size at birth and litter weight weaning compared with $G_{75\%}$.These results agreed with those obtained by Khalil (1998) ,and Abokhadiga,(2004) .The number of dead kits from birth to weaning per reproductive cycle were the highest in the $G_{0\%}$ and $G_{25\%}$ (1.577)compared with (1.156)$G_{75\%}$ possibly as a result of lowest feed intake $G_{0\%}$ diet , consequently ,the smaller litter size of G0% was due to insufficient diet to provide the necessary amount of producing milk in $G_{0\%}$ .Also, data showed that does receiving the $G_{75\%}$ weaned larger and heavier litter at 21st day. These results agree with those of Gonzalez and Herrera (2012) and Caro (2014).

Table (4):Effect of SDMOL on rabbit reproductive performance of does.

Item	$G_{0\%}$	$G_{25\%}$	$G_{50\%}$	$G_{75\%}$
No. of does	15	15	15	15
[1]LSB	6.422[c]	7.377[b]	7.622[a]	7.866[a]
[2]LSA	4.844[c]	5.800[b]	6.466[a]	6.711[a]
Mortality as a number	1.577	1.577	1.1556	1.1556
[3]LWB	250.98[c]	330.76[b]	377.64[a]	392.44[a]
[4]LWW	2678.18[d]	2765.60[c]	2982.60[b]	3162.73[a]

a,b,c, Means having different common letter within each group are significant different

[1]LSB= Litter size at birth *[2]LSA= Litter size a live*

[3]LWB= Litter weight at birth *[4]LWW= Litter weight weaning*

The present results show that the does received the different levels of SDMOL(25,50 and 75%) produced significantly heavier kits weight at birth and at weaning than those of control treatment .These results agree with Odeyinka *et al*. (2008)who found that does received high level of *Moringa oleifera* (M100) had higher weight at weaning than does received low level of *Moringa oleifera*(M25) . The present results indicate that replacing 75 % of soya protein in rabbit's ration by SDMOL increased litter weight at weaning by 18.09% as compared with $G_{0\%}$ group. This enhancement in litter weight at weaning may be due to the effects of SDMOL on metabolic rate or improving efficiency in conversion of milk to body gains in litters (Never, (2018).

Milk yield and composition

Data in Table (5) showed that milk yield was significantly increased as the level of SDMO was increased. The greatest milk yield was observed in does fed the $G_{75\%}$ compared to the $G_{0\%}$. These results agree with Markus *et al*.,(2017) who found that the higher level of moringa oliefera leaves meal increased ($P<0.05$) prolactin hormone concentration followed by increasing milk production. Also, Kholif *et al*.,

Table (5): Effect of SDMOL on milk yield and composition of rabbit does.

Item	$G_{0\%}$	$G_{25\%}$	$G_{50\%}$	$G_{75\%}$
Milk yield in 1st Kindling(g/21 days)	1807.27	1865.33	1881.13	1949.87
Fat %	12.86	12.78	12.78	12.74
Protein %	10.222	10.426	11.644	12.986
Ash %	2.08c	2.26b	2.52a	2.38ab
Lactose %	1.91	1.776	1.848	1.750
Milk yield in 2nd Kindling(g/21 days)	1884.93	1919.33	1961.80	1962.93
Fat %	12.86	12.76	12.77	11.9
Protein %	10.66	10.51	12.67	13.18
Ash %	2.08	2.26	2.52	2.38
Lactose %	1.91	1.8	1.84	1.87
Milk yield in 3rd Kindling(g/21 days)	2179.47	2273.33	2303.53	2372.27
Fat %	12.84	12.72	11.80	11.57
Protein %	10.66	10.51	12.67	13.18
Ash %	2.22	2.26	2.22	2.50
Lactose %	1.91	1.87	1.84	1.80
Over all means of Milk yield (g/21 days)	1957.722[d]	2019.33[c]	2048.82[b]	2095.02[a]
Over all means of Fat%	12.849[a]	12.756[a]	12.453[b]	12.072[c]
Over all means of Protein%	10.417[c]	10.712[c]	12.189[b]	13.174[a]
Over all means of Ash%	2.140[c]	2.306[b]	2.36[b]	2.460[a]
Over all means of Lactose%	1.910[a]	1.818[b]	1.845[a]	1.809[b]

a,b,c, Means having different common Letter within each group are significant different.

(2015) explained the increased milk production as a result of the increased feed intake .In addition overall mean of ash was increased by 14.953% in $G_{75\%}$. Overall mean of lactose was decreased by 5.287 in $G_{75\%}$. The same trend was observed for milk protein content which was increased by 26.46% while milk fat

content was decreased by 6.047%,respectively .Rabbit milk composition varies depending on many factors, such as genetically (breeds ,age ,lactation stage and number of pups and environmentally (nutrition , external parasites and heat)(Lukafahr *et al*.,1983).Data presented in Table (5) showed that milk yield, during the three kindling was significantly higher ($p < 0.01$)for does fed the different levels of SDMOL than that does fed control diet .The over all of milk yield were 1957,219,2048 and 2071, respectively for $G_{0\%}$, $G_{25\%}$, $G_{50\%}$ and $G_{75\%}$.

The total milk production obtained in 21 days with does received $G_{75\%}$ was a little bit lower than that described by Khalil (1998) in Egypt for the Baladi red(2150 g) and the Baladi black (2180 g). It was lower than the 2640 g described by the same author for the Giza white, but clearly lower than the 3567 g observed by Mohamed and SzendrÖ (1992) for litters of 6 kits in a Californian line selected in Hungary. This relatively low milk production can be related to the relatively small adult weight (3.0 kg). Significant differences were found in the content of milk fat, protein and lactose.

Effect of parites on milk yield

Results of milk yield recorded during the third parity (Table 5) showed higher in milk yield compared to the second and first parites however, the second parity was better than the first parity. This increase may be due to the cumulative effect of feeding the sun dried *Moringa oleifera* leaves.Tuma *et al*., (2010) found that parity order affected service number of pregnancy and litter weight at 21 days followed by increase in milk yield. The results in (Table5) showed that parities had a positive influence ($p<0.01$) on both milk yield and their chemical composition. Also, over all means of milk yield and protein percentage were the highest in $G_{75\%}$ compared to $G_{25\%}$ .These results are in agreement with the finding of Khalil(1998).

Feed conversion

Data in Table (6) showed that Feed conversion was better in treated groups than control group during the three kindling . $G_{75\%}$ recorded the best value(1.840) followed by $G_{50\%}$ (1.872)then $G_{25\%}$ (1.943), while $G_{0\%}$ recorded the worest value (1.994 (FI g/LWW g) .Although the overall means of total feed intake(kg/doe)in treated groups were higher, the overall means of feed conversion in treated groups were better than the control group in order to increase the number of kids treated groups .The higher number kids and best feed conversion rations were obtained in does fed rations contained SDMOL. Present data show that the does feed $G_{75\%}$ were more efficient ($p<0.01$)compared with those fed $G_{0\%}$ in converting feed into milk during the three weeks post-partum period .

Table (6): Feed intake and feed conversion of rabbits does fed diets containing 0, 25, 50 and75% SDMOL.

Item	$G_{0\%}$	$G_{25\%}$	$G_{50\%}$	$G_{75\%}$
No. of animals	15	15	15	15
1st Total feed intake (kg/doe) (26days)	4.378	4.518	4.414	4.763
1st FID(g/doe/day)	168.4	173.8	169.8	183.2
Litter Weight Weaning(g)	2476.07	2598.93	2907.07	3040.87
1st Feed conversion ratio (FI g/LWW g)	1.768	1.738	1.698	1.566
2nd Total feed intake (kg/doe) (26days)	5.829	5.714	5.886	5.995
2nd FID(g/doe/day)	224.2	219.8	226.4	230.6
Litter Weight Weaning(g)	2708.93	2771.2	2925.8	3106.07
2nd Feed conversion ratio (FI g/LWW g)	2.151	2.062	2.011	1.93
3rd Total feed intake (kg/doe) (26 days)	5.886	5.943	6.453	6.708
3rd FID(g/doe/day)	226.4	258.6	248.2	258.0
Litter Weight Weaning(g)	2851.33	2926.67	3114.93	3341.27
3rd Feed conversion ratio (FI g/LWW g)	2.063	2.031	2.071	2.006
Over all means Total feed intake (kg/doe)	5.364	5.391	5.584	5.822
Over all means Litter Weight Weaning(g)	2678.78^{d}	2765.60^{c}	2982.60^{b}	3162.73^{a}
Over all means of Feed conversion ratio.	1.994	1.943	1.872	1.840

Where: a,b,c, Means having different common Letter within each group are significant different.
FID =Feed intake daily.

CONCLUSION.

Moringa oleifera leaves can be used as an alternate for conventional concentrate in the diet of rabbit does due to its high crude protein content. It is recommended that replacing 75% soybean meal *Moringa oleifera* leaves could be used as a source of protein supplement for rabbit does.

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تأثير العلائق المحتوية علي مستويات مختلفة من أوراق المورينجا المجففة شمسياً علي محصول لبن الارانب والاداء الانتاجي

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أجريت الدراسة علي عدد 60 انثي من سلالة النيوزيلاندي الابيض في عمر ستة شهور لمدة ثلاثة مواسم تلقيح متتالة قسمت الي اربعة مجاميع بكل مجموعة خمسة عشر ارنب 0غذيت المجموعة الاولي علي العليقة المقارنة بينما غذيت المجموعة الثانية والثالثة والرابعة علي العليقةالمقارنة مع استبدال نسب 25% ؛50%؛75%من مصدر البروتين بها(كسب الفول الصويا) باوراق المورينجا المجففه شمسياً علي التوالي0أستمرت التجربة لمدة ثلاثة مواسم تلقيح متتالية (96 يوم).

اوضحت النتائج زيادة متدرجة معنويه في انتاج اللبن وعدد الخلفة عند الميلاد كلما زادت نسبة إحلال المورينجا وجد ان زيادة أنتاج اللبن تبعه زيادة معنوية عند مستوي 1% في وزن الخلفة عند الفطام.

أدي استخدام اوراق المورينجا اوليفيرا الي زيادة معنوية في بروتين لبن الامهات بنسبة 46و26% وانخفاض في دهن لبن الامهات بنسبة 047و6% للمجموعة التي تغذت علي عليقة بها نسبة أحلال 75% من كسب الصويا باوراق المورينجا أوليفيرا المجففة شمسياً مقارنة بالمجموعة الكنترول.

وقد خلصت نتائج هذة التجربة إلي أن استخدام أوراق المورينجا اوليفيرا المجففة شمسياً أدت الي تحسن كلا من عدد المواليد الحية والمفطومة نتيجة تحسن كمية اللبن وعدم وجود أي أثار سلبية علي الارانب الا ان الكفاءة الاقتصادية للمجموعةالمقارنه كانت افضل وذلك لارتفاع سعر المورينجا اوليفيرا المجففة شمسياً لذا ينصح باضافتها كإضافات غذائية وليس أحلال من مصدر بروتين عليقة الارانب.