ABSTRACT: A total number of 18 New Zealand White buck rabbits with (2671± 185g average initial body weight and 24 weeks of age were used in this study to evaluate the effect of dietary inclusion of different levels of Moringa oleifera hay (leaves+ twigs) as a partial substitute for alfalfa hay on their reproductive and productive performance. The animals were randomly allotted to three experimental groups (6 bucks in each). The 1st group was served as a control and fed basal pelleted diet (Diet A) contained 18% alfalfa hay, represents about 14.7 % of the total crude protein of the diet. The 2nd and 3rd groups were fed the same basal diet, but 50 and 75% of alfalfa hay (B and C Diets, respectively) were replaced by moringa hay (leaves+ twigs) on the basis of its contents of protein. Buck rabbits fed Diet B and C had improving semen quality. Mean values of physical semen characteristics were significantly higher (P < 0.01) for buck rabbits fed Diet B and C as compared to those fed Diet A (control). The correlation coefficients (r) between testosterone and each of ejaculate volume, wave motion, sperm motility, live spermatozoa, sperm concentration and total sperm output were significantly (P < 0.05 and 0.01) positive and ranged between 0.57 to 0.91. However, negative (P < 0.01) correlation coefficients were detected between testosterone concentration and abnormal spermatozoa (-0.85). The coefficients of determination ($r^2$) between testosterone and each of ejaculate volume, wave motion, sperm motility, live spermatozoa, sperm concentration, abnormal spermatozoa and total sperm output were significant (P < 0.05 and 0.01) and ranged between 0.33 to 0.83. The results of the present study demonstrate that Moringa oleifera hay (leaves+ twigs) is good unconventional source of protein for feeding buck rabbits and could be added in the diet at levels up to 13.5% to replace about 75% of alfalfa hay without any adverse effects on their reproductive traits. 

Key word: Moringa oleifera, reproductive traits, buck rabbits
INTRODUCTION

Shortage of animal feedstuffs is the main obstacle facing the development of animal production in Egypt. Inadequate nutrition for animals and poultry resulted in low milk, eggs and meat production, in addition that human population is increasing rapidly which led to more decrease in animal products. Many attempts are devoted to solve this problem, among these, cultivation of unconventional new forage crops that tolerate drought and salinity in the newly reclaimed soils in Sinai and north coast of Egypt.

*Moringa oleifera* plant is one of the most of widely distributed species of family moringaceae. *Moringa oleifera* is a perennial tree grows in most of the tropics and has several industrial, agricultural and medicinal uses, therefore is so called the life tree. It tolerates drought, high environment temperature up to 45°C (Morton, 1991) and a wide range of soils (pH from 4.5-9, Palada and Changl, 2003). Moringa plants can be harvested several times during the growing season. One hectare cultivated area gives about 240 tons or more green forage resulted from 8 cuts in the year (Foidl *et al.*, 2001). Moringa leaves are rich in antioxidants that have high capacity to scavenge free radicals and play a significant role in reducing mortality and morbidity due to cancer, heart diseases and other chronic illness. *Moringa oleifera* leaves meal are good source of high quality protein and can be used to replace soya bean or groundnut cake in livestock diet (Makker and Becker, 1997 and Sarwatt *et al.*, 2002). Leaves meal of *Moringa oleifera* are abundant also in many of essential vitamins, and minerals (Fuglie and Lowell, 2001, Anwar and Bhanger, 2003, Siddhuraju and Becker, 2003, Anhwange *et al.*, 2004 and Anwar *et al.*, 2007).

The phenolic compounds present in moringa leaves, could serve as antioxidants and may effectively scavenge various reactive oxygen species and free radicals under *in vivo* conditions. Moreover the aqueous extract of moringa leaves contains certain biologically active components (selenium, thiocarbamates, glucosinolates, and their hydrolysis products such as glucoraphanin, isothiocyanate sulforaphane, nitriles, Faizi *et al.*, 1994).

Therefore, the present study was carried out to ascertain the effects of inclusion of moringa hay (leaves and twigs) at different levels in the diet (to substitute alfalfa hay) on reproductive and productive performance of bucks NZW rabbits under Egyptian condition.

MATERIALS AND METHODS
The experimental work of the present study was carried out at Rabbits Research Unit, Department of Animal and Poultry Production, Faculty of Technology and Development, Zagazig University, Zagazig, Egypt. The experimental work was initiated in December 2015 and terminated in October, 2016 by using bucks at sexual maturity (24 weeks of age) and till fulfillment of three parities. A total number of 18 bucks of New Zealand White buck rabbits, 24 weeks old and with average initial body weight of 2671 ± 185g were randomly allotted into three experimental groups (six bucks in each) to evaluate the physical semen quality. The 1st bucks group was served as a control and fed a basal pelleted diet (Diet A) that contained 18% alfalfa hay, represents about 14.7% of the total crude protein of the diet. The 2nd and 3rd groups were fed Diets B and C, where 50 and 75%, respectively of alfalfa hay in the basal diet were replaced by moringa hay (leaves + twigs). All the experimental diets were iso nitrogenous and iso caloric.

Moringa plants were cultivated at Research Farm of Faculty of Technology and Development, Zagazig University. All plants were harvested at 90 days of growth and each 45 days after there for the following successive cuts. Representative samples of the air-dried moringa leaves and twigs were taken for chemical analysis, also samples of feed ingredients of the experimental diets were taken for chemical analysis to determine crude protein, crude fiber, ether extract, nitrogen free extract, calcium and phosphorus according to the methods of AOAC (1995). Chemical analysis was performed in the Central Lab for Soil, Foods and Feedstuffs (International accredited Lab, since 2012 and has ISO 17025), Faculty of Technology & Development, Zagazig University, Egypt. The diets were formulated to meet the nutrient requirements of rabbits for reproduction according to NRC (1977). The diet were mixed and pelleted at a commercial feed mill of Atmida, Meet Ghamr, Dakahlia Governorate, Egypt.

Chemical analysis of alfalfa hay and *Moringa oleifera* is presented in Table 1.

| Chemical analysis | Alfalfa hay | *Moringa oleifera* hay |
|-------------------|------------|------------------------|
|                   | Dry matter | Crude protein | Ether extract | Crude fiber | NFE | Ash |              | Leaves | Twigs |
|                   | 10.93±0.11 | 14.80±0.58     | 2.20±0.03      | 28.20±2.13  | 34.90 | 8.97±0.06 | 100     | 100     | 100   |
|                   | 8.03±0.11  | 24.40±0.84     | 5.20±0.07      | 19.20±0.82  | 34.20 | 8.97±0.06 | 100     | 100     | 100   |
|                   | 6.20±0.56  | 6.20±0.04      | 3.20±0.04      | 43.00±2.51  | 29.10 | 9.36±0.05 | 100     | 100     | 100   |
|                   | 9.14±0.10  | 6.20±0.04      | 3.20±0.04      | 43.00±2.51  | 29.10 | 9.36±0.05 | 100     | 100     | 100   |
|                   | 100        | 100           | 100            | 100         | 100   | 100       | 100     | 100     | 100   |

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Table 1: Chemical analysis of alfalfa hay and *Moringa oleifera* hay (leaves and twigs)

Ingredients and chemical composition of the experimental pelleted diets are shown in Table 2.

### Table (2): Ingredients and chemical analysis of the experimental diets

| Ingredients            | Diet A  | Diet B  | Diet C  |
|------------------------|---------|---------|---------|
| Yellow corn            | 16.00   | 16.00   | 16.00   |
| Barley                 | 18.00   | 18.00   | 18.00   |
| Wheat bran             | 26.00   | 26.00   | 26.00   |
| Soybean meal (44%)     | 19.00   | 19.00   | 19.00   |
| Alfalfa hay            | 18.00   | 9.00    | 4.50    |
| Moringa leaves meal    | 0.00    | 4.50    | 7.00    |
| Moringa twigs meal     | 0.00    | 4.50    | 6.50    |
| Limestone              | 2.00    | 2.00    | 2.00    |
| Salt                   | 0.50    | 0.50    | 0.50    |
| Vit. & Mineral Premix* | 0.30    | 0.30    | 0.30    |
| Methionine             | 0.10    | 0.10    | 0.10    |
| Anti Mycotoxins        | 0.10    | 0.10    | 0.10    |
| **Total**              | 100.00  | 100.00  | 100.00  |

**Chemical analysis:**

- Dry matter: 14.27, 13.32, 13.89
- Crude protein: 18.38, 18.70, 19.11
- Ether extract: 2.22, 2.26, 2.51
- Crude fiber: 10.64, 10.81, 11.13
- Ash: 9.56, 9.22, 9.13
- NFE: 44.93, 45.69, 44.23
- Lysine**: 0.99, 1.21, 1.31
- Ca: 0.88, 0.94, 0.99
- P: 0.52, 0.56, 0.57
- Meth+cysteine**: 0.65, 0.79, 0.85

*Vitamin and minerals premix at level of 0.3% of diet supplies the following per Kg of diet: Vit. A 12000 IU, Vit. D3 2000 IU, Vit E 10 mg, Vit. K1 2mg, Vit B1 1mg, Vit B2 5mg, VitB6 1.5 mg, Vit. B12 10 mg; Niacin 30 mg, Pantothenic acid 10 mg; Folic acid 1mg, Choline 250 mg, Biotin 50 mg, Copper 5mg, Manganese 60 mg, Zinc 50mg, Iron 30mg, Iodine 0.3 mg Selenium 0.1mg and Cobalt 0.1mg.

**Calculated according to NRC (1977)

All bucks were fed pelleted diets and drinking water *ad libitum* throughout the experimental period. All bucks were kept under the same managerial and hygienic conditions.
Semen samples were collected once a week for eight consecutive weeks using an artificial vagina device as described by Walton (1958). Each ejaculate was taken to measure physical semen characteristics (ejaculate volume, wave motion, sperm motility, sperm concentration, live and abnormal spermatozoa and total sperm output).

**Statistical analysis:**
Data were statistically analyzed using Least Squares Analysis of Variance according to Snedecor and Cochran (1982) using the General Linear Model Program of SPSS (2004) using the following fixed model for bucks:

\[ Y_{ij} = \mu + T_i + e_{ij} \]

Where, \( Y_{ij} \) = The observed value of a given dependent variable, \( \mu \) = Overall adjusted mean, \( T_i \) = Fixed effect of the treatments (Moringa olifera hay substitution), \( i = 1, 2 \) and \( 3, e_{ij} \) = Error of the model.

The differences between LSM (least square means) were analyzed by Duncan's New Multiple Range test (Duncan, 1955). Data in percentage values were transformed with the arcsine square root procedure to normalize variance before analysis.

**RESULTS AND DISCUSSION**

**Effects of dietary inclusion Moringa oleifera hay on physical semen characteristics of NZW buck rabbits.**

Table 3 shows that ejaculate volume (ml) was significantly higher (\( P<0.01 \)) in buck rabbits fed Diets B and C than those fed Diet A. These results are in agreement with those obtained by EL Deeb et al. (2015) who showed that supplementation of Moringa oleifera leaves at levels 4 and 8 % increased semen volume in rabbits due to its high nutritive value which subsequently enhanced fertility performance. Improving ejaculate volume may reveal beneficial effect of Moringa oleifera leaves as antioxidant on accessory sex glands and testicular tissues (spermatocytes) within the seminiferous tubules as well as on epididymal spermatozoa (Awoniyi, 2010).

Wave motion (score) and sperm motility (%) was significantly higher (\( P < 0.01 \)) in buck rabbits fed Diet B and C than those fed Diet A. These results agreed with those reported by EL Deeb et al. (2015) and Khalifa et al. (2016) who observed that sperm motility percentages were significantly increased in rabbits fed Moringa oleifera leaves meal. Yusuf (2014) showed that sperm motility was significantly higher in Turkey toms treated with Moringa oleifera leaves extract. The same author suggested that Moringa
oleifera leaves meal might enhanced the development and activity of the seminiferous tubules and the interstitial cells of turkey toms as well as possible role in enhancing hormonal functions.

Table 3. Means and standard error for physical semen characteristics of NZW buck rabbits fed different levels of Moringa oleifera hay (leaves + twigs) as a substitute for alfalfa hay in the diet.

| Physical semen characteristics | Buck rabbit groups | Sig |
|--------------------------------|--------------------|-----|
|                                | A(Control)         | B   | C   |
| Ejaculate volume(ml)           | 0.6±0.02<sup>a</sup> | 0.9±0.04<sup>a</sup> | 0.9±0.04<sup>a</sup> | ** |
| Wave motion(score)             | 2.8±0.11<sup>b</sup> | 3.4±0.11<sup>a</sup> | 3.5±0.10<sup>a</sup> | ** |
| Sperm motility (%)             | 70.0±1.16<sup>b</sup> | 78.2±1.3<sup>a</sup> | 81.4±1.2<sup>a</sup> | ** |
| Live spermatozoa (%)           | 73.7±1.13<sup>b</sup> | 79.7±0.99<sup>a</sup> | 83.5±1.3<sup>a</sup> | ** |
| Abnormal spermatozoa (%)       | 21.5±1.3<sup>a</sup> | 16.2±0.9<sup>b</sup> | 12.7±0.6<sup>b</sup> | ** |
| Sperm concentration (x10<sup>6</sup>) | 147.5±7.5<sup>e</sup> | 212.5±7.7<sup>b</sup> | 266.6±11.6<sup>a</sup> | ** |
| Total sperm output (x10<sup>6</sup>) | 90.1±6.2<sup>b</sup> | 194.5±11.3<sup>a</sup> | 228.1±15.3<sup>a</sup> | ** |

** =P < 0.01, 
<sup>a</sup>, <sup>b</sup>, <sup>c</sup> Means with different superscript in the same row differ significantly(P < 0.05). 
Group A (control): was fed a basal pelleted diet contained zero% Moringa oleifera hay (leaves+ twigs). 
Group B: was fed a diet contained 9% Moringa oleifera hay as a substitute for 50% of alfalfa hay in basal diet. 
Group C: was fed a diet contained 13.5% Moringa oleifera hay as a substitute for 75% of alfalfa hay in basal diet.

Live spermatozoa percentages were significantly higher (P < 0.01) in buck rabbits fed Diets B and C(83.5±1.3% and 79.7±0.9%, respectively) compared with buck rabbits fed Diet A (73.7±1.1%). These results are in agreement with the findings of Fatoba et al. (2013) who treated rats with moringa root extract. The same authors recorded increased mass activity and sperm cell livability than the control. Also, the same author observed a persistent dose dependent with moderate increase in sperm viability percentage for rabbit bucks fed diets contained 50% and 75% Moringa oleifera. Consequently, rabbit bucks under the control diet have higher percentages of nonviable spermatozoa than the treated rabbit bucks, leading to that sperm viability in rabbits is at least partly influenced by the amount of supplementation of natural antioxidant source. Amin and Hamza (2005) suggested that the protective effects of Moringa leaves may be attributed to the
presence of phytoconstituents (polyphenols, tannins, anthocyanin, glycosides, thiocarbamates) that scavenge free radicals, activate the antioxidant enzymes, and inhibit oxidases.

The differences in abnormal spermatozoa percentages among the experimental groups were highly significant (P<0.01). The mean percentages of abnormal spermatozoa of buck rabbits fed Diet A (control group) was significantly higher (P < 0.01) than those fed Diets B or C. These results are in agreement with those obtained by Kabbashi and Allah (2016) who reported that dietary moringa leaves extract supplementation decreased abnormal sperm percentage in albino rats. Priyadarshani and Varma (2014) found that hyperglycaemia induced sperm morphological defects in mice and a subsequent repair mechanism with moringa leaves meal was achieved by decreasing in sperm headless, banana head, amorphous head, round head and coiled tail sperm in large quantity. *Moringa oleifera* leaves contain fundamental antioxidants and phenolic compounds that helps in protecting the testis against morphologic, spermatogenic and oxidative changes brought about by toxic materials and certain antineoplastic agents (Sidduraju and Becker, 2003 and Saalu et al., 2011).

Mean values of sperm concentrations were significantly higher (P <0.01) in buck rabbits fed Diet C (266.6 x10^6) followed by those fed Diet B (212.5 x10^6) and Diet A (147.5 x10^6). These results are in agreement with those reported by Yusuf (2014) who found a significant increase in sperm concentration in Turkey toms treated with *Moringa oleifera* leaves meal. The high sperm concentrations recorded in *Moringa oleifera* treated toms suggest that testicular development and proper hormone balance were triggered by treatment with *Moringa oleifera* leave meal. Also Ghodaia (2016) reported an increase in sperm count in buck rabbits.

Mean values of total sperm output were significantly higher (P < 0.01) for buck rabbits fed Diets B and C (194.5±11.3 and 228.6±15.3, respectively) as compared with those fed Diet A (90.1±6.2). These results are in agreement with those obtained by Fatoba et al. (2013) who reported that dietary supplementation with Moringa root extract supplementation significantly increased the total sperm output of albino rats. The improvement in semen quality may be due to that *Moringa oleifera* leaves have excellent source of protein, micronutrients such as vitamins (B-carotene, ascorbic acid and tochoferols) an minerals (calcium, potassium, iron, zinc and selenium). *Moringa oleifera* leaves contain also, many of antioxidants such as Kaempferol, Quercetin, Rutin and Caffeoylquinic acids (Fuglie, 1999).
Table 4 shows that the mean values of cholesterol (mg/dl), alanine amino transferase (ALT) and testosterone concentration were significantly (P<0.05 or P < 0.01) increased in rabbits fed Diets B and C than those fed the control. However, total protein, albumin, globulin, glucose; aspartate amino transferase (AST) levels were not significantly affected by *Moringa oleifera* hay feeding. These results are agree with those obtained by Afolabi *et al.* (2013) who reported that treatment of cryptorchid rats with *Moringa oleifera* leaves extract in seminal plasma increased the total protein level. Ghodaia (2016) reported that seminal plasma proved to be of great biochemical interest as it contains many organic compounds. These substances produced by various accessory glands in response to testosterone hormone (El-Sherbieny, 2004).

The biochemical components in seminal plasma play a pivotal role in providing substrate energy forming essential link in the energy generating cycles in sperm metabolism during the process of fertilization and in the maintenance of constant osmotic pressure during semen preservation (Dhami and Kodagali, 1987). Estimation of this biochemical in the ejaculated semen or directly in the glands can be used as an index of accessory glands function (White, 1976).

### Table 4. Means and standard error for seminal plasma of NZW buck rabbits fed different levels of *Moringa oleifera* hay (leaves + twigs) as a substitute for alfalfa hay in the diet.

| Seminal plasma components                          | Buck rabbit groups | Sig   |
|---------------------------------------------------|--------------------|-------|
|                                                   | (Control)          | B     | C     |
| **Total protein (g/dl)**                          | 3.8±0.4            | 3.9±0.7| 4.1±0.1| NS   |
| **Albumin (g/dl)**                                | 1.9±0.1            | 1.9±0.2| 2.1±0.1| NS   |
| **Globulin (g/dl)**                               | 1.9±0.2            | 2.0±0.2| 2.1±0.1| NS   |
| **Glucose (mg/dl)**                               | 49.3±0.6           | 49.2±0.4| 49.5±0.5| NS   |
| **Cholesterol (mg/dl)**                           | 41.0±1.6<sup>a</sup> | 24.3±1.8<sup>c</sup> | 32.0±1.2<sup>b</sup> | ** |
| **Aspartate amino transferase (IU)**              | 41.1±0.8           | 41.2±1.1| 40.5±1.1| NS   |
| **Alanine amino transferase (IU)**                | 18.7±0.5<sup>a</sup> | 16.8±0.5<sup>b</sup> | 16.9±0.2<sup>b</sup> | *   |
| **Testosterone (ng/ml)**                          | 2.6±0.0<sup>b</sup> | 2.9±0.1<sup>a</sup> | 3.1±0.0<sup>a</sup> | ** |

NS= Not-significant, *= P < 0.05 and ***= P < 0.01,

a, b, c Means with different superscript on the same row differ significantly(P < 0.05),

**Group A (Control):** was fed a basal pelleted diet contained zero% *Moringa oleifera* hay (leaves+twigs).
Group B: was fed a diet contained 9% *Moringa oleifera* hay as a substitute for 50% of alfalfa hay in basal diet.

Group C: was fed a diet contained 13.5% *Moringa oleifera* hay as a substitute for 75% of alfalfa hay in basal diet.

**Interrelationship between testosterone and semen characteristics traits:**

Table 5 shows that the correlation coefficients (r) between testosterone and each of volume, wave motion, sperm motility, live spermatozoa, sperm concentration and total sperm output were significantly (P < 0.05 or P < 0.01) positive and ranged between 0.57 to 0.91. However, negative (P < 0.01) correlation coefficients between sperm abnormalities (-0.85) were detected.

The coefficients of determination ($r^2$) between testosterone and each of volume, wave motion, sperm motility, live spermatozoa, sperm concentration, sperm abnormalities and total sperm output were significant (P < 0.05 or P < 0.01) and ranged between 0.33 to 0.83.

**Table 5.** Correlation coefficients (r) and coefficients of determination ($r^2$) between testosterone and semen characteristics of NZW buck rabbits fed different levels of *morninga oleifera* hay as a substitution for alfalfa hay.

| Correlated traits                  | R     | $r^2$  | Sig |
|-----------------------------------|-------|--------|-----|
| **Testosterone:**                 |       |        |     |
| Volume (ml)                       | 0.57  | 0.33   | NS  |
| Wave motion (score)               | 0.82**| 0.67   | **  |
| Sperm motility (%)                | 0.89**| 0.79   | **  |
| Live Spermatozoa (%)              | 0.78* | 0.61   | **  |
| Abnormal spermatozoa (%)          | -0.85**| 0.72   | **  |
| Sperm concentration (x10^6)       | 0.91**| 0.83   | **  |
| Total sperm output (x10^6)        | 0.90**| 0.81   | **  |

NS= Not-significant and **= P < 0.01.

Conclusively, the results of the present study demonstrate that *Moringa oleifera* hay (leaves+ twigs) is good source of protein for feeding buck rabbits and could be added in their diet at levels up to 13.5% to replace about 75% of alfalfa hay without any adverse effects on their reproductive traits.

**REFERENCES**

Afolabi, A.O.A., Hameed, A. A. and Isiaka, A. A., (2013). Effects of methanolic extract of *Moringa oleifera* leaves on semen and
biochemical parameters in cryptorchid rats. *African Journal of Traditional and Complementary Medicine*, 10(5):230-235.

**Amin, A. and Hamza, A. A. (2005).** Hepatoprotective effects of Hibiscus, Rosmarinus and salvia on azathioprine-induced toxicity in rats. *Life Sciences*, 77 (3): 266–278.

**Anhwange, B.A., Ajibola, V.O and Oniye, S.J. (2004).** Chemical studies of the seeds of Moringa oleifera (Lam.) and detarium microcarpum (Guill and Sperr). *Journal of Biology Sciences*, 4: 711–715.

**Anwar, F, Latif, S, Asharaf, M. and Gilani, A. (2007).** *Moringa oleifera*: a food plant with multiple medicinal uses, *Phytother Research*, 21: 17 – 25.

**Anwar, F. and Bhanger, M.I. (2003).** Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan *Journal of Agricultural Food Chemical*, 51: 6558-6563.

**AOAC. (1995).** *Association official Analytical Chemists Official Methods of Analysis*, 16 th edition, USA.

**Awoniyi, D.O. (2010).** The role of rooibos (asperalthus linearis), green tea (camellia sinensis) and commercially available rooibos and green tea antioxidant supplements on rat testicular and epididymal function. *M. Sc. Faculty of Health and Wellness Sciences, Cape Peninsula University, of Technology.*

**Dhami, A. J. and Kodagali, S. B. (1987).** Correlation between biochemical and enzymatic constituents of serum of Suri buffalo bulls. *Indian Journal Animal Science*, 57:1283.

**Duncan, D.B. (1955):** Multiple range and multiple F tests. *Biometrics*, 11: 1-42.

**El Deeb, M. A., Afifi, O. S., Mahmoud, H. A. and Refay, M. S. (2015).** Effect of nutritional and functional properties of *Moringa Oleifera* leaves (MOL) on: I. Semen quality and offspring performance of New Zealand white (NZW) bucks. *Assiut Journal Agriculture Sciences*, 46 (2): 120-134.

**El-Sherbieny, M. A. S. (2004).** Physiological study on farm animals. Ph.D. *Thesis, Faculty of Agriculture Mansoura University, Egypt.*

**Faizi S., Siddiqui, B.S., Saleem, R., Siddiqui, S., Aftab, K. and Gilani, A.H. (1994).** Isolation and structure elucidation of new nitrile and mustard oil glycosides from *Moringa oleifera* and their effect on blood pressure. *Journal of Natural Products*, 57: 1256-1261.

**Fatoba, T. A., Faleyimu, O. I. and Adebayo, A. J. (2013).** The effects of increasing aqueous root extract of *Moringa oleifera* on sperm production of albino rats. *Agro Search*, 13(1): 29 - 36.
Foidl, N., Makkar, H.P.S. and Becker, K. (2001). The potential of *Moringa oleifera* for agricultural and industrial uses. In: Fugile, L.J. (ed). *The miracle tree: the multiple attributes of Moringa*. CTA. Publication. Wageningen, The Netherlands, pp 45-76.

Fuglie, L. J and J.E. Lowell (2001). The miracle tree: *Moringa oleifera*: Natural Nutrition for the Tropics. Training Manual. Church World Service, Dakar, Senegal. [www.moringatrees.org/moringa/miracletree.htm](http://www.moringatrees.org/moringa/miracletree.htm).

Fuglie, L.J. (1999). *The Miracle Tree*. *Moringa oleifera*: Natural nutrition for the tropic. Church world service, Dakar Senegal. 68 pp., Revised in 2001 and published as the *miracle Tree: The multiple Attributes of Moringa*, 172.

Ghodaia, A. E.B. (2016). Physiological studies on some factors affecting semen quality and preservation methods of rabbit bucks fed moringa. Ph.D. Thesis, Faculty of Agriculture, Mansura University, Egypt.

Kabbashi, A. S. and Allah, M. (2016). Effect of ethanol extract of *Moringa oleifera* leaves on fertility hormone and sperm quality of male albino rats. *World Journal of Pharmaceutical Research*, 5 (1): 1-11.

Khalifa, W. H., Faten M. Ibrahim., Aida I. El Makawy, Hafiza A. Sharaf., Wagdy K. B. K. and Nagwa A. Maghraby (2016). Safety and fertility enhancing role of *Moringa oleifera* leaves Aqueous extract in New Zealand White rabbit bucks. *International Journal Pharmacy*, 6(1): 156-168.

Makker, H.P.S and Becker, K. (1997). Nutrients and anti-quality factors in different morphological parts of the *Moringa oleifera* tree. *Journal of Agriculture Sciences (Cambridge)*, 128:311-322.

Morton, J.F. (1991). The horseradish tree. *Moringa pterigosperma* (*Moringaceae*). Aboon to arid lands. *Econ Bot.*, 45: 318-333.

NRC (1977). Nutrients requirements of domestic animals. *nutrients requirements of rabbits*. 2nd Edition. *National Research Council, National Academy of Science*. Washington, DC. USA.

Palada, M.C. and Changl, L.C. (2003). Suggested cultural partices for moringa. *International Cooperators Guide* AVRDC. AVRDC pub 03-545 [www.avrdc.org](http://www.avrdc.org). Org.

Priyadarshani, N. and Varma, M.C. (2014). Effect of *Moringa oleifera* leaf powder on sperm count, histology of testis and epididymis of hyperglycemic mice *Mus musculus*. *American International Journal of Research in Formal Applied & Natural Sciences*, 7(1): 07-13.
Saalu, L.C., Osinubi, A.A., Akinbami, A.A., Yama, O.E., Oyewopo, A.O. and Enaibe, B.U. (2011). *Moringa oleifera* lamarck (drumstick) leaf extract modulates the evidences of Hydroxyurea induced testicular derangement. *International Journal of Applied Research in Natural Products*, 4 (2): 32-45.

Sarwatt, S.V., Kapange, S.S. and Kakengi, A.M.V. (2002). Substituting sunflower seed cake with *Moringa oleifera* leaves as a supplemental goat feed in Tanzania. *Agroforestry Systems*, 56: 241–247.

Sidduraju, P. and Becker, K. (2003). Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (*Moringa oleifera* Lam) leaves. *Journal Agriculture Food Chemical*, 51(8): 2144-55.

Snedecore, G.W. and Cochran, W.G. (1982). *Statistical Methods*. 6th ed. Iowa State University Press. Ames, Lowa, U.S.A.

SPSS (2004). *Statistical Package for Social Sciences*, Chicago, U.S.A.

Walton, A. (1958). Improvement in the design of an artificial vagina for the rabbit. *Journal of Physiology*, 143:26-28.

White, I. G. (1976). Reproduction in male. *Veterinary Physiology*. Ed Byj. W Phillis, Phillis; Wrightscient echnica.

Yusuf, M. (2014). Semen quality and egg hatchability in local turkey fed Diets containing *Moringa oleifera* and *gongronema Latifolium* leaf meal. Department of Animal Science, Faculty of Agriculture, University of Nigeria, Nsukka. Thesis.

الاستفادة من المورينجا الاوليفر ا كعلف جديد للارانب

3- تأثير الدمج الغذائي لحيوان المورينجا على الأداء التناسلي لارانب بورك

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استخدم في هذه الدراسة عدد 18 أرنب باك أبيض نيوزيلندا بمتوسط (2671 ± 185 جم متوسط وزن الجسم الأولي وعمر 24 أسبوعًا لتقييم تأثير التضمين الغذائي لمستويات مختلفة من قش المورينجا (الأوراق + الأغصان). بدأ جزئي لدرس البرسوم في أدائها الإنجابي والإنتاجي. تم تخصص الحيوانات عشوائياً لثلاث
تجميعات تجريبية (6 ذكور في كل مجموعة) ، المجموعة الأولى كانت بمثابة ضابطة وتبذيرية الحبيبات القاعدية (عالية A) احتوت على 18٪ من البروتيوم يمثل التنهاً حوالي 14.7٪ من إمجالي البروتين الخام للنظام الغذائي. تتبذيرية المجموعتين الثانية والثالثة على نفس النظام الغذائي الأساسي ، ولكن تم استبدال 50 و 75٪ من درس البروتيوم (عالية B و C على التوالي) ببروتيوم (الورق + الأغصان) على أساس محتواهما من البروتينات. كانت ذكور أرانب التي تغذى على النظام الغذائي المنوي. كانت القيم المتوسطة لخصائص السائل المنوي الجسدية أعلى معنويًا بمقارنة بتلك C و B التي تغذى على النظام الغذائي المنوي (P<0.01) لذكور الأرانب التي تغذى على النظام الغذائي المنوي B و C (المقارن). كانت معمارلة الارتباط (r) بين هرمون التستيرون وكل من حجم السائل المنوي وحركة الموجة وحركة الحيوانات المنوية الورقية والحميات المنوية الحية وتركيز الحيوانات المنوية وحجم الحيوانات المنوية وعوضة تحت تكزير (P<0.05) وتراوحت بين 0.57 و 0.91 مع ذلك ، تم الكشف عن معمارلة الارتباط السلبية (P<0.01) بين تكزير هرمون التستيرون والحميات المنوية غير الطبيعية (P<0.85). كانت معامرات التحديد (r) بين التستيرون وكل من حجم السائل المنوي ، وحركة الموجة ، وحركة الحيوانات المنوية ، وعوضة المنوية الحية ، وتوزع الحيوانات المنوية ، وعوضة المنوية غير الطبيعية ، وإجمالي نتائج الحيوانات المنوية وعوضة (P<0.05) وتراوحت بين 0.33 و 0.83. النتائج: تظهر نتائج الدراسة الحالية أن تقنية المورينجا أوريجيرا (أوراق + أغصان) هو مصدر جيد غير تقليدي للبروتينات لتنبيه ذكور الأرانب ويمكن إضافته في النظام الغذائي بمستويات تصل إلى 13.5٪ ليحل محل حوالي 75٪ من قش البروتيوم دون أي آثار ضارة. على صفاتها التناسبية.