**Egyptian Poultry Science Journal**

**http://www.epsaegypt.com**

**ISSN: 1110-5623 (Print) – 2090-0570 (On line)**

# COMPARATIVE STUDY FOR SEMEN QUALITY TRAITS AND FERTILIZING ABILITY FOR SUDANI DRAKES FED DIFFERENT ENERGY AND PROTEIN DIETS

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Received: 16/04/2015 Accepted: 16/05/2015

**ABSTRACT**: This study was conducted to investigate the effects of different dietary metabolizable energy (ME) and crude protein (CP) levels on semen quality traits, some seminal and blood plasma constituents as well as fertilizing ability of Sudani drakes. A total number of 54 Sudani drakes 32-wks-old, at the same time, 189 Sudani ducks were taken for detecting the fertilizing ability of drakes and then hatchability (%). All birds from drakes and ducks were weighed and divided into nine experimental groups of three replicates each, in a factorial arrangement design (3x3). The dietary treatments were 2750 (low), 2850 (medium) and 2950 (high) ME kcal/kg, each contained 15 (low), 17 (medium) and 19% CP (high) levels. The results indicate that Sudani drakes fed the high level of both ME and CP had significantly higher ejaculate volume and sperm concentration. Also, advanced motility of sperms was significantly improved for drakes fed high-ME diet, while, dead, coiled, clumping and coiled /total abnormal sperms were significantly decreased than those fed low-ME diet. The total abnormal sperms was significantly decreased by increasing CP level in the diet only. Seminal plasma acid phosphatase activity and total lipids content were significantly higher for drakes fed high-ME diet than those fed low-ME diet. On the other hand, feeding high-CP diet resulted in a significant decrease of seminal plasma albumin concentration, ALT and AST enzymes activity than those fed medium-CP diet, while acid phosphatase activity was insignificantly decreased.

Blood plasma acid phosphatase , ALT and AST enzymes activity were significantly ($P \leq 0.05$) increased, whereas, total lipids and cholesterol were insignificantly decreased for drakes fed high-ME diet comparing to those fed low-ME diet. Also, Blood plasma content of globulin and total cholesterol were significantly ($P \leq 0.05$) decreased, while acid phosphatase activity was significantly ($P \leq 0.05$) increased for drakes fed high-CP diet than those fed low-CP diet. Fertility and hatchability percentages were improved by increasing both ME and CP level in the diet without significant effect, the best values of them were occurred by the interaction of high-ME with high or medium-CP in the diet. These results indicate that a diet containing 2950 Kcal ME/kg with 17 or 19% CP could be used to improve the semen quality traits and fertilizing ability for Sudani drakes without adverse effect on fertility and hatchability traits for hatching eggs.

**Key Words:** Energy, Protein, Semen Quality, Fertility and Sudani Drakes.

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## INTRODUCTION

Reproduction is one of the aspects of poultry breeding. Furthermore, fertility is one of the major reproductive parameters in poultry since it highly determines chick's production (Tadondjou et al., 2014). Good breeding programs of ducks require active drakes that can enhance the chance of obtaining expected results of breeding (Etuk et al., 2006). Semen quality plays a prominent role in artificial insemination in order to increase fertile eggs production from ducks, because artificial insemination may be a method to alleviate the unsatisfactory fertility problems in ducks resulting from the impaired mating behavior (Nahak et al., 2015). Semen quality of drakes can be used to enhance the reproductive traits, where the differences in semen quality traits such as ejaculate volume, sperms concentration, motility as well as abnormality may be affected by many factors such as breed, age, body size, nutrition, seasonal temperatures, as well as deficiency of some vitamins such as A and E (Almahdi et al., 2014).

Energy and protein are important nutrients, representing the majority of total cost, since optimal their levels are important for lowering feed cost per unit of poultry product. Corn and soybean meal prices are increasing greatly in recent years. It is therefore important to formulate diets to efficiently meet the needs of dietary metabolizable energy (ME) and crude protein (CP) for optimum performance for poultry (Li et al., 2011). The nutrient requirements of males have received much less attention than those of females and it is common for males to receive diets that are formulated to meet the nutrient requirements of female (Etches,1996). Ducks production has been developed in last decade in Egypt, but the low reproductive efficiency has hindered its continued expansion. Also, ME and CP level in the diet are important for producing good quantity and quality sperms with low dead and abnormal spermatozoa from local Domyati drakes which affect on fertility improvement (Ghonim et al., 2010).

Sudani ducks is one of local duck breeds in Egypt, it looks like Muscovy ducks in the feathers form and the red crest around the eyes and above the beak, but, it is less than in the productive traits. There is a little attention of the producers due to low productivity resulting from subfertility and hatchability, although their meats are more favorable to the Egyptian consumer. With development of poultry production in Egypt, ducks production is becoming specialized and more attention is focused lately on increasing meat (Kout Elkloub et al., 2010), and egg production from local breeds of ducks (Awad et al., 2011). However, the energy and protein requirements are still poorly documented for these breeds such as Sudani ducks (Awad et al., 2013&2014) especially drakes. Therefore, the purpose of the present study was to evaluate semen quality traits, blood and seminal plasma constituents, and fertilizing ability of Sudani drakes under feeding with different metabolizable energy and crude protein diets.

## MATERIALS AND METHODS

The present study was conducted at El- Serw Research Station, Water Fowl branch, Water Fowl Research Department, Animal Production Research Institute, Agricultural Research Center, Ministry of Agricultural, Egypt. It was started in October 2013 and terminated in January 2014. Two hundred and forty three of Sudani birds (189 ducks and 54 drakes) at 32-wks-old were used. The drakes were randomly chosen and divided into nine equal experimental groups (6 drakes each), then were kept in individual cages (50x50x40cm), while the ducks were randomly divided into nine groups also (21 ducks each) and kept in separate open-air pens. All birds were exposed to 17 h light: 7 h dark as daily photoperiod and the light

intensity was adjusted to be 10 Lux as recommended by Tag EL-Din et al. (2006). The experiment was arranged in factorial design (3X3) to investigate the effect of different dietary levels of metabolizable energy (ME) and crude protein (CP) in the diet on semen quality traits and fertilizing ability of Sudani drakes. The first factor was ME level {2750 (low), 2850 (medium) and 2950 (high) kcal ME/kg diet}, and the second factor was CP level {15 (low), 17 (medium), and 19 (high) % CP}. Both drakes and ducks in the same group fed the same experimental diet from the beginning of the training period until the end of the eggs collection for hatching. The composition and calculated analysis of experimental diets are presented in Table 1.

Data collection and estimated parameters:

**Semen collection and physical traits:-**

Initially, all experimental drakes were selected on the basis of a positive reaction to dorso-abdominal massage for artificial semen collection and then were trained for four weeks (Kammer et al., 1972). After training, the cloacal region of each drake was cleaned. Semen was collected twice a week from each drake in clean and dry graduated tubes for three weeks to determine semen characteristics. Semen volume was measured (in milliliter) by using graduated collection plastic tubes. Mass and advanced motility were estimated immediately after semen collection. Sperm concentration was estimated by using an original haemocytometer. The percentage of dead, total abnormalities, coiled, and clumping of sperms were estimated by using nigrocin /eosin staining procedure (Bakst and Cecil, 1997).

**Blood plasma samples**:

Blood samples were taken from the wing vein for three drakes from each experimental group in heparinized test tubes, immediately after semen collection for testing semen quality parameters. All blood samples were centrifuged at 3500 rpm for 15 minutes to obtain blood plasma. Then, they were stored in a deep freezer at approximately -20 $^{o}$C until the analysis. Plasma total protein and albumin were determined calorimetrically by using available commercial kits (Peters, 1968). However, globulin was obtained by the differences, while total cholesterol was determined according to Ellefson and caraway (1976) and total lipids according to Bucolo and David (1973). Alkaline and Acid phosphatase activities were determined according to Moss (1984) and transaminases enzymes activities (ALT and AST) according to Reitman and Frankel (1957).

**Seminal plasma constituents**:

Freshly semen samples were taken individually for each drake from all experimental drakes, centrifuged at 4000 rpm for 10 min to collect the seminal plasma. Samples of seminal plasma were stored at −20°C until used for the determination of total protein, albumin, both acid and alkaline phosphatases, alanine- aminotransferase (ALT) and aspartate aminotransferase (AST) activities and total lipid and cholesterol. The determination of the previous parameters of seminal plasma were similar as blood plasma determination by available commercial kits.

**Fertilizing ability test**:

After determination of semen quality parameters, semen was collected to evaluate the fertilizing ability of drakes, then hatchability traits. Freshly semen was pooled for drakes from each experimental group for artificial insemination process. Sudani ducks in different experimental groups were starved for 15 h before artificial insemination. Ducks were inseminated three times during the first week of artificial insemination period, then every three days for six weeks, at 10.0 AM by using 0.05 ml raw semen / duck from their respective drakes within 30 min of collection time. Hatching eggs were

collected after the second week of artificial insemination up to the end of experimental period and incubated in three hatches to evaluate fertility and hatchability percentages. The eggs were set in an automatic incubator and incubated at 37.5°C and 65% relative humidity. Fertility was determined by candling eggs on the $10^{th}$ day of incubation, then hatchability percentage of fertile eggs was calculated at the end of incubation period.

**Statistical analysis**:

Data obtained were statistically analyzed using the general linear model of SAS (2004). In this study, a 3x3 factorial design was used, considering the energy level and crud protein level as the main effects, as follows:

Yijk = μ + Ti +Rj + (TR)ij+ eijk where :

Yijk = an observation;

μ = Overall mean;

T = Effect of energy level; i= (1,2 and 3) ;

R = Effect of crud protein level; j = (1, 2 and 3) ;

TR=Effect of interaction between energy and crud protein level; and

eijk = Random error.

Significant differences among treatments means were tested by Duncan's multiple range test (Duncan, 1955).

## RESULTS AND DISCUSSION

**Semen quality parameters:**

Significant (P≤ 0.05) differences were observed in all studied semen parameters of Sudani drakes by feeding diets contained varying ME levels except of mass motility and total abnormal sperms which not affected (Table 2). The drakes fed diet contained high-ME level had significantly (P≤ 0.05) higher values of ejaculate volume, sperms concentration and advanced motility than those fed low-ME diet. Moreover, they had significantly (P≤ 0.05) low values of dead, coiled, clumping and coiled/ total abnormal of sperms. Also, it is noticed that drakes fed high-ME diet had significant improvement of pervious parameter than those fed the medium-ME diet except for the advanced motility, dead and coiled sperms percentage which recorded insignificant improvement. It appears that the dietary energy level effect was more obvious on ejaculate volume, sperms concentration, and mass and advanced motility score as well as sperms abnormalities (Almahdi et al., 2014). This may be related to the nutritional deficiencies could depress the production and quality of semen in the male (McDonald, 1980), because nutrition affects the endocrine rather than the spermatogenic function of the testis (Hafez, 1987). Also, the improvement of semen quality may be due to that high energy intake leads to increase testis weight and accelerate testicular development which could be improved the development of seminiferous tubules in testis (Teteh et al., 2010), and testis produce both sperm and part of seminal plasma suggesting that testis development is not only associated with sertoli cell proliferation but also with establishment of spermatogenesis activity (Lűpold et al., 2011). These results are consistent with those obtained by Ghonim et al. (2010) who reported that Domyati drakes fed diet contained high-ME level (2950 kcal/kg) had the higher ejaculate volume and concentration of sperms and lower total abnormal sperms than those fed low-CP level (2750 kcal/kg). Similarly, Tadondjou et al. (2013) reported that ejaculate volume and spermatozoa mass motility were significantly (P≤ 0.05) higher for cocks by feeding diet contained 3000 kcal/kg than those fed 2900 kcal/kg diet.

On the other hand, using different levels of CP in Sudani drake's diet has significant (P≤ 0.05) effects on some semen quality parameters such as ejaculate volume, concentration of sperms and total abnormal (Table 2). Drakes fed high-CP

diet gave significantly (P≤ 0.05) higher values of ejaculate volume by 40.0, 21.74% and sperm concentration by 9.52 and 4.55% as well as it significantly recorded (P≤ 0.05) lower value of total abnormal of sperms by 10.58 and 12.26% than those fed low and medium-CP diet, respectively. Moreover, feeding high-CP diet resulted in improving mass and advanced motility of sperms and decreasing coiled and clumping sperms than low and medium-CP diets. Improvement of semen production and quality may be due to the diet could be supplied enough protein requirement for testicular development and sertoli cell proliferation which were affected on semen production and quality (Etches, 1996). These results are consistent with the results obtained by Wilson et al. (1987) who reported that decreasing dietary CP level in the diet had an adverse effect on semen quality. Ghonim et al. (2010) reported that Domyati drakes fed diet contained high-CP level (19%) had the higher ejaculate volume and sperms concentration and lower total abnormality sperms than those fed on medium (17%) and low-CP level (15%). In contrary, Hocking and Bernard (1997) and Zhang et al. (1999) reported that spermatozoa concentration and semen volume for broiler breeder males were low as a result of feeding diet contained 16% CP as compared with 12% CP diet, this may be due to the differences in energy and protein between duck and broiler breeder males (Siregar and Farrel, 1980 and Etches, 1996).

No significant differences on semen quality parameters for Sudani drakes were observed as a result of the interaction between different ME and CP levels in the diets except of ejaculate volume and sperms concentration which were significantly affected (Table 2). The interaction between high-ME and high-CP level gave significantly (P≤0.05) higher value for ejaculate volume than the other interactions, while, the interaction between high-ME with different CP levels resulted in significantly (P≤ 0.05) high values of sperms concentration compared to the other interactions. On the other hand, the interaction between high-ME and high-CP recorded the higher value of mass and advanced motility of sperms and lower values of coiled and clumping sperms than other interactions. It is likely that the high ME and CP levels are important for producing good quality sperms with low dead and abnormal spermatozoa. These holds true for both ME&CP which are the main sources for all physiological and endocrinological mechanisms in the body. These results are similar with the results obtained by Ghonim et al. (2010) who reported that the combination of high-ME (2950 kcal/kg) with high-CP (19%) in the diet resulted in the best ejaculate volume and concentration of sperms and lower percentage of dead and abnormal sperms as compared to other combinations for Domyati drakes.

**Seminal plasma constituents:**

All studied seminal plasma constituents were not significantly affected due to feeding different ME diets except of acid phosphatase activity and total lipids (Table 3). Drakes fed high-ME diet had significantly higher seminal plasma acid phosphatase than those fed medium or low-ME diets, while, feeding both high and medium-ME diet resulted in significant higher seminal plasma total lipid than those fed low-ME diet. These results may be due to the high sperms concentration, where sperm motility was correlated with lipid components which needed to increase sperms motility (Wishart and Palmer, 1986 and Cerolini et al., 1994). Also, phospholipid fraction plays a major role in regulating membrane fluidity, ionic interactions, and membrane excitation and also interacts with and regulates a range of membrane proteins and enzymes (Salem et al., 1986). These results are consistent with the results obtained by Ghonim et al. (2010)

who reported that seminal plasma albumin concentration, alkaline phosphatase and AST enzymes activity were not significantly affected by feeding different ME diets for Domyati drakes.

Moreover, different crude protein (CP) levels in Sudani drakes diet had significant ($P \leq 0.05$) effect on some seminal plasma constituents such as albumin, acid phosphatase and liver AST and ALT enzyme (Table 3). Drakes fed medium-CP diet had higher values of albumin concentration, acid phosphatase and liver AST and ALT enzymes activity than those fed high or low- CP diets with or without significant effects. These results are consistent with the results obtained by Ghonim et al. (2010) who reported that seminal plasma albumin and ALT enzyme were significantly decreased by feeding diet contained high-CP level for Domyati drakes than those fed low-CP level in the diet, while, seminal plasma alkaline phosphatase enzyme activity was not significantly affected by feeding different CP diets.

No significant differences were observed due to the interaction between ME and CP levels in sudani drake diets on all studied seminal plasma constituents except of acid phosphatase, ALT and AST enzymes activity which were significantly affected (Table 3). It is noticed that, the drakes fed diet contained high-ME and medium-CP recorded significantly higher values of acid and alkaline phosphatase enzymes, whereas, the drakes fed medium-ME and medium-CP diet had significantly higher values of ALT and AST enzymes. Drakes fed diet contained the combination of high-ME and high-CP had higher value of seminal plasma total cholesterol. Also, seminal plasma total protein and albumin content were recorded the lowest values for drakes fed diet contained the combination of high level of both ME and CP. These results are consistent with the results obtained by Ghonim et al. (2010) who reported that seminal plasma total protein, albumin and globulin content had the lowest values for drakes fed diet contained the combination of high level of both ME and CP.

**Blood plasma constituents:**

Blood plasma constituents of Sudani drakes, measured in the present study, were estimated to show the metabolic status of drakes and their health as affected by feeding varying ME and CP levels in the diet. Data of blood plasma constituents of Sudani drakes as affected by feeding diet contained varying levels of ME, CP and their interactions are presented in Table 4. The drakes fed high-ME diet had significantly ($P \leq 0.05$) higher values of blood plasma acid phosphatase, ALT and AST enzymes activity than those fed low-ME diet. Blood plasma total lipid and cholesterol were significantly increased for drakes fed low-ME diet than those fed medium-ME diet. These results are in agreement with those obtained by Zhang et al.(2008) who reported that plasma ALT and AST enzymes activity were increased for chicks which fed ad-libitum the high energy diet as compared to those fed low energy diet. Also, Awad et al. (2013) reported that increasing ME level in Sudani ducks diet resulted in significant increase of AST enzyme and non-significant effects on other blood plasma constituents. In contrary, plasma total lipids and triglycerides were significantly ($P<0.05$) increased of adult pigeons (Abdel-Azeem et al., 2007) and Domyati laying ducks (Awad et al., 2011) when ME levels increased in the diet. Also, Ghonim et al. (2010) reported that increasing ME level in the diet had decreased blood plasma acid phosphatase and albumin concentration of Domyati drakes.

On the other hand, varying CP levels had no significant effect on some studied plasma constituents such as total protein, albumin, AST enzyme, alkaline phosphatase and total lipids (Table 4). The drakes fed high-CP diet had significantly

(P≤ 0.05) lower blood plasma globulin, ALT enzyme and total cholesterol content as compared with those fed low-CP diet, while it were significantly (P≤ 0.05) higher in acid phosphatase content (Table 4). These results are in agreement with those obtained by Awad et al. (2011) reported that feeding different CP levels in laying diets had no significant effects on serum total protein, ALT and AST of Domyati ducks. In contrary, Awad et al. (2013) reported that increasing CP level in Sudani duck diet resulted in non-significant effects on previous plasma constituents. Also, Ghonim et al. (2010) reported that increasing CP level in the diet resulted in significant decrease in plasma total protein, alkaline phosphatase and significant increase in blood plasma AST enzyme activity of Domyati drakes.

A significant differences were noticed in some studied blood plasma constituents such as globulin, acid phosphatase, AST enzyme and total cholesterol as a result of the interaction between dietary ME and CP levels (Table 4). Drakes fed diet contained the combination of medium or high-ME with both medium and high-CP had significantly (P≤ 0.05) lower value of blood plasma total cholesterol, whereas, the highest values of acid phosphatase and AST enzymes were occurred by the interaction between high-ME and medium-CP level. It is likely that the effect of dietary ME and CP levels on blood enzymes was not greater enough to reflect any deleterious effects on liver function. The obtained increases or decreases in ALT or AST enzymes level and to some extent acid or alkaline phosphatase level in blood may be a result of protein degradation and energy metabolism in the body which may affect kidney and liver function.

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**Fertility and hatchability traits:**

Results of fertility and hatchability percentages of eggs produced after artificial insemination of ducks by drakes semen are presented in Table 5. Both fertility and hatchability percentages were not significantly affected as a result of feeding different ME and CP levels in the diets for Sudani drakes. It is observed that, the drakes received the high level of both ME or CP in the diet recorded high value of fertility, subsequently high value of hatchability (%) of fertile eggs. The best values of both fertility (95.67& 94.35%) and hatchability (75.93& 74.97%) were occurred by the interaction between high-ME with high then medium-CP level. These results may be due to the improvement of semen quality for these groups especially sperms concentration. These results are in agreement with the results obtained by Ghonim et al. (2010) who reported that fertility of eggs was improved by feeding diet contained high-ME (2950 kcal/kg), while it was improved by feeding diet contained low-CP (15%) for Domyati drakes. Also, they reported that the best value of hatchability was occurred by the interaction between high-ME and both medium and high-CP of Domyati ducks.

## CONCLUSION

It is concluded that the ME and CP levels in the diet are important for producing good quality sperms with low dead and abnormal spermatozoa from Sudani drakes which cause an improvement of fertilizing ability. It is suggested that a diet containing 2950 Kcal ME/kg and 17-19% CP could be used to improve semen quality traits and fertilizing ability for Sudani drakes without adverse effect on fertility and hatchability traits for hatching eggs

**Table( 1)** : Composition and calculated analysis of the experimental diets.

| Ingredients % | Metabolizable energy level (ME) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low | | | Medium | | | High | | |
| | Crude protein level (CP) | | | | | | | | |
| | Low | Med | High | Low | Med | High | Low | Med | High |
| Yellow corn | 67.5 | 64.5 | 60.5 | 71.0 | 67.3 | 63.0 | 73.5 | 69.5 | 65.5 |
| Soya bean meal (44%) | 19.5 | 24.5 | 25.5 | 16.7 | 18.2 | 18.3 | 09.3 | 10.0 | 10.5 |
| Gluten (62%) | 00.0 | 01.0 | 04.0 | 02.3 | 05.0 | 08.7 | 07.2 | 10.5 | 14.0 |
| Wheat bran | 03.0 | 00.0 | 00.0 | 00.0 | 00.0 | 00.0 | 00.0 | 00.0 | 00.0 |
| Di-calcium phosphate | 1.70 | 1.70 | 1.70 | 1.70 | 1.70 | 1.70 | 1.70 | 1.70 | 1.70 |
| Limestone | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| Vit & Min. premix * | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Salt ( NaCl ) | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| DL. Methionine(97%) | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Calculated Analysis**** | | | | | | | | | |
| Crude protein % | 14.99 | 17.08 | 19.04 | 15.01 | 17.03 | 19.00 | 15.00 | 17.02 | 19.07 |
| ME ( Kcal / kg ) | 2743 | 2752 | 2752 | 2845 | 2854 | 2858 | 2946 | 2950 | 2957 |
| Total Calcium % | 3.30 | 3.31 | 3.31 | 3.29 | 3.29 | 3.29 | 3.27 | 3.27 | 3.27 |
| Av. Phosphorus % | 0.43 | 0.44 | 0.44 | 0.42 | 0.43 | 0.43 | 0.41 | 0.42 | 0.42 |

*Each 3 kg of the Vit and Min. premix manufactured by Agri-Vit Company, Egypt contains: Vitamin A 10 MIU, Vit. D 2 MIU, Vit E 10 g, Vit. K 2 g, Thiamin 1 g, Riboflavin 5 g, Pyridoxine 1.5 g, Niacin 30 g, Vit. $B_{12}$ 10 mg, Pantothenic acid 10 g, Folic acid 1.5 g, Biotin 50 mg, Choline chloride 250 g, Manganese 60 g, Zinc 50 g, Iron 30 g, Copper 10 g, Iodine 1g, Selenium 0. 10 g, Cobalt 0.10 g. and carrier $CaCo_3$ to 3000 g..

** According to NRC ( 1994 )

**Table 2** : Effect of dietary metabolizable energy and crude protein levels on semen quality parameters of Sudani drakes.

| Traits / Main effects | | Semen quality parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Volume (ml)** | **Concent. (mlx10$^9$)** | **Mass motility** | **Advanced motility** | **Dead sperms** | **Coiled** | **Clumping** | **Total abnormal** | **Coiled/T. abnormal** |
| **Metabolizable energy level (ME)** | | | | | | | | | | |
| Low | | 0.21±0.02$^b$ | 4.2±0.1$^c$ | 4.4±0.2 | 85.3±2.1$^b$ | 7.8±0.4$^a$ | 4.8±0.4$^a$ | 6.7±0.3$^a$ | 10.6±0.3 | 44.8±3.5$^a$ |
| Medium | | 0.23±0.02$^b$ | 4.4±0.2$^b$ | 4.4±0.2 | 88.4±1.4$^{ab}$ | 6.7±0.5$^{ab}$ | 4.2±0.2$^{ab}$ | 4.4±0.2$^b$ | 9.9±0.4 | 43.0±2.7$^a$ |
| High | | 0.28±0.05$^a$ | 4.7±0.2$^a$ | 4.8±0.2 | 92.0±1.3$^a$ | 6.0±0.5$^b$ | 3.3±0.3$^b$ | 3.2±0.4$^c$ | 9.9±0.4 | 33.8±2.5$^b$ |
| Significance | | 0.05 | 0.05 | NS | 0.05 | 0.05 | 0.05 | 0.05 | NS | 0.05 |
| **Crude protein level (CP)** | | | | | | | | | | |
| Low | | 0.20±0.02$^b$ | 4.3±0.1$^c$ | 4.4±0.2 | 87.0±1.8 | 7.3±0.6 | 4.4±0.4 | 5.1±0.6 | 10.4±0.4$^a$ | 42.4±3.2 |
| Medium | | 0.23±0.02$^b$ | 4.4±0.1$^b$ | 4.4±0.2 | 87.9±1.9 | 6.4±0.6 | 4.1±0.3 | 5.0±0.6 | 10.6±0.3$^a$ | 39.1±3.3 |
| High | | 0.28±0.05$^a$ | 4.6±0.1$^a$ | 4.8±0.2 | 90.9±.6 | 6.7±0.4 | 3.8±0.4 | 4.2±0.5 | 9.3±0.3$^b$ | 40.0±3.7 |
| Significance | | 0.05 | 0.05 | NS | NS | NS | NS | NS | 0.05 | NS |
| **Interactions** | | | | | | | | | | |
| **ME** | **CP** | | | | | | | | | |
| Low | Low | 0.19±0.02$^b$ | 3.9±0.03$^d$ | 4.3±0.3 | 83.3±3.3 | 8.7±0.7 | 5.3±0.7 | 7.0±0.6 | 11.0±0.6 | 48.0±6.4 |
| | Med. | 0.22±0.02$^b$ | 4.2±0.01$^c$ | 4.3±0.3 | 85.0±5.0 | 7.3±0.7 | 4.7±0.7 | 7.0±0.6 | 10.7±0.3 | 43.3±5.5 |
| | High | 0.22±0.01$^b$ | 4.4±0.02$^b$ | 4.7±0.3 | 87.7±2.7 | 7.3±0.7 | 4.3±0.9 | 6.0±0.6 | 10.0±0.6 | 43.0±8.5 |
| Med | Low | 0.22±0.01$^b$ | 4.4±0.01$^b$ | 4.3±0.3 | 87.3±2.8 | 7.3±0.7 | 4.3±0.9 | 4.7±0.3 | 10.0±0.6 | 43.0±1.5 |
| | Med | 0.23±0.02$^b$ | 4.4±0.01$^b$ | 4.3±0.3 | 88.0±2.1 | 6.0±1.2 | 4.3±0.6 | 4.7±0.3 | 10.7±0.9 | 41.7±7.2 |
| | High | 0.24±0.03$^b$ | 4.5±0.01$^b$ | 4.7±0.3 | 90.0±2.9 | 6.7±0.7 | 4.0±0.3 | 4.0±0.6 | 9.0±0.6 | 44.3±5.6 |
| High | Low | 0.19±0.03$^b$ | 4.7±0.03$^a$ | 4.7±0.3 | 90.0±2.6 | 6.0±1.2 | 3.7±0.3 | 3.7±0.9 | 10.3±0.9 | 36.3±5.8 |
| | Med | 0.25±0.02$^b$ | 4.7±0.01$^a$ | 4.7±0.3 | 90.0±2.3 | 6.0±1.2 | 3.3±0.3 | 3.3±0.9 | 10.3±0.3 | 32.3±3.9 |
| | High | 0.38±0.03$^a$ | 4.8±0.02$^a$ | 5.0±0.1 | 95.0±0.6 | 6.0±0.6 | 3.0±0.6 | 2.7±0.3 | 9.0±0.6 | 32.7±4.3 |
| Significance | | 0.05 | 0.05 | NS | NS | NS | NS | NS | NS | NS |

a,b,c,d: means in the same column bearing different superscript are significantly different ( $P \leq 0.05$ ).

**Table (3)** : Effect of dietary metabolizable energy and crude protein levels on seminal plasma constituents of Sudani drakes.

| Traits / Main effects | | Seminal plasma constituents | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Total protein (g/dl)** | **Albumin (g/dl)** | **Globulin (g/dl)** | **Acid phosphatase (U/L)** | **Alkaline phosphatase (U/L)** | **ALT (U/L)** | **AST (U/L)** | **Total lipids (mg/dl)** | **Total Cholesterol (mg/dl)** |
| **Metabolizable energy level (ME)** | | | | | | | | | | |
| Low | | 1.89±0.05 | 0.92±0.03 | 0.96±0.03 | 49.5±2.3$^{b}$ | 21.0±0.5 | 13.1±0.6 | 73.2±3.4 | 75.7±2.1$^{b}$ | 97.3±2.6 |
| Medium | | 1.90±0.04 | 0.95±0.03 | 0.96±0.02 | 50.3±2.7$^{b}$ | 21.0±0.7 | 13.3±0.8 | 72.8±4.5 | 83.0±1.9$^{a}$ | 101.3±3.8 |
| High | | 1.96±0.07 | 0.93±0.03 | 1.03±0.05 | 56.8±1.6$^{a}$ | 22.0±0.6 | 14.1±0.3 | 77.8±1.3 | 81.8±2.4$^{a}$ | 104.3±4.3 |
| Sig. | | NS | NS | NS | 0.05 | NS | NS | NS | 0.05 | NS |
| **Crude protein level (CP)** | | | | | | | | | | |
| Low | | 1.95±0.05 | 0.93±0.03$^{ab}$ | 1.01±0.04 | 48.7±2.1$^{b}$ | 20.8±0.5 | 13.3±0.54$^{ab}$ | 75.5±3.7 $^{a}$ | 79.7±2.4 | 99.2±0.8 |
| Medium | | 1.97±0.06 | 0.98±0.03$^{a}$ | 0.99±0.04 | 55.2±2.2$^{a}$ | 21.2±0.7 | 14.6±0.43$^{a}$ | 80.0±1.9 $^{a}$ | 80.8±2.6 | 102.5±3.0 |
| High | | 1.84±0.04 | 0.89±0.02$^{b}$ | 0.94±0.03 | 52.7±2.7$^{ab}$ | 21.9±0.6 | 12.7±0.6$^{b}$ | 68.2±3.2$^{b}$ | 80.0±2.2 | 101.3±5.8 |
| Sig. | | NS | 0.05 | NS | 0.05 | NS | 0.05 | 0.05 | NS | NS |
| **Interactions** | | | | | | | | | | |
| **ME** | **CP** | | | | | | | | | |
| Low | Low | 1.90±0.05 | 0.91±0.06 | 0.93±0.06 | 43.0±1.3$^{e}$ | 20.6±1.0 | 14.5±0.6$^{ab}$ | 84.3±1.8$^{ab}$ | 73.3±3.9 | 100.5±0.3 |
| | Med | 1.99±0.13 | 0.97±0.05 | 1.02±0.08 | 47.9±2.1$^{cde}$ | 20.0±0.5 | 13.7±0.5$^{bc}$ | 73.7±1.8$^{bcd}$ | 76.8±2.6 | 102.5±4.3 |
| | High | 1.79±0.06 | 0.87±0.02 | 0.92±0.04 | 57.7±1.8$^{d}$ | 22.4±0.5 | 11.1±0.4$^{d}$ | 61.5±2.2$^{e}$ | 77.1±4.9 | 89.0±3.5 |
| Med | Low | 1.90±0.06 | 0.90±0.03 | 1.00±0.04 | 46.8±2.3$^{de}$ | 21.9±0.7 | 12.0±1.2$^{cd}$ | 64.8±7.7$^{de}$ | 81.2±3.3 | 99.0±2.3 |
| | Med | 1.96±0.09 | 1.05±0.05 | 0.91±0.04 | 55.9±2.0$^{abc}$ | 20.2±0.9 | 15.3±0.9$^{a}$ | 85.0±2.4$^{a}$ | 85.7±3.9 | 110.0±5.8 |
| | High | 1.85±0.06 | 0.90±0.04 | 0.95±0.02 | 48.3±7.3$^{cde}$ | 21.1±1.9 | 12.7±1.3$^{bcd}$ | 68.5±8.2$^{cde}$ | 82.1±3.3 | 95.0±8.7 |
| High | Low | 2.05±0.13 | 0.98±0.05 | 1.10±0.08 | 56.3±0.3$^{abc}$ | 20.0±0.5 | 13.5±0.4$^{bc}$ | 77.5±1.2$^{abc}$ | 84.7±2.3 | 98.0±0.6 |
| | Med | 1.98±0.10 | 1.93±0.03 | 1.05±0.07 | 61.9±0.8$^{a}$ | 23.6±0.4 | 14.7±0.7$^{ab}$ | 81.3±0.5$^{ab}$ | 80.0±6.3 | 95.0±0.6 |
| | High | 1.87±0.12 | 0.90±0.06 | 0.94±0.09 | 52.1±2.2$^{bcd}$ | 22.3±0.7 | 14.3±1.7$^{ab}$ | 74.7±2.5$^{bcd}$ | 80.7±4.0 | 120.0±5.8 |
| Sign. | | NS | NS | NS | 0.05 | NS | 0.05 | 0.05 | NS | NS |

a,b,c,d,e: means in the same column bearing different superscript are significantly different ( $P \leq 0.05$ ).

**Table (4)** : Effect of dietary metabolizable energy and crude protein levels on blood plasma constituents of Sudani drakes

| Traits / Main effects | | Blood plasma constituents | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total protein (g/dl) | Albumin (g/dl) | Globulin (g/dl) | Acid phosphatase (U/L) | Alkaline phosphatase (U/L) | ALT (U/L) | AST (U/L) | Total lipids (mg/dl) | Total Cholesterol (mg/dl) |
| **Metabolizable energy level (ME)** | | | | | | | | | | |
| Low | | 5.23±0.08 | 2.91±0.09 | 2.32±0.05 | 18.5±0.8$^{b}$ | 59.0±1.3 | 13.1±0.5$^{b}$ | 63.8±1.6$^{b}$ | 823.5±9.6$^{a}$ | 230.9±6.7$^{a}$ |
| Medium | | 5.26±0.09 | 2.91±0.06 | 2.36±0.07 | 18.6±0.9$^{b}$ | 58.0±1.8 | 14.2±0.8$^{ab}$ | 62.9±2.3$^{b}$ | 761.7±25.3$^{b}$ | 215.0±7.2$^{b}$ |
| High | | 5.28±0.07 | 2.97±0.08 | 2.30±0.09 | 20.9±0.6$^{a}$ | 60.0±1.2 | 15.6±0.5$^{a}$ | 67.5±1.8$^{a}$ | 782.3±15.1$^{ab}$ | 218.9±10.4$^{ab}$ |
| Sig. | | NS | NS | NS | 0.05 | NS | 0.05 | 0.05 | 0.05 | 0.05 |
| **Crude protein level (CP)** | | | | | | | | | | |
| Low | | 5.35±0.06 | 2.93±0.06 | 2.43±0.04$^{a}$ | 17.8±0.7$^{b}$ | 58.4±1.1 | 14.3±0.5$^{ab}$ | 64.5±2.1 | 795.9±16.3 | 237.2±7.8$^{a}$ |
| Medium | | 5.29±0.09 | 2.94±0.08 | 2.35±0.08$^{a}$ | 20.3±0.9$^{a}$ | 58.3±1.3 | 15.3±0.8$^{a}$ | 66.7±2.2 | 772.6±19.3 | 211.8±6.1$^{b}$ |
| High | | 5.13±0.10 | 2.93±0.09 | 2.2±0.04$^{b}$ | 19.9±0.9$^{a}$ | 60.4±1.9 | 13.3±0.6$^{b}$ | 62.9±1.5 | 799.0±22.7 | 215.8±8.7$^{b}$ |
| Sig. | | NS | NS | 0.05 | 0.05 | NS | 0.05 | NS | NS | 0.05 |
| **Interactions** | | | | | | | | | | |
| **ME** | **CP** | | | | | | | | | |
| Low | Low | 5.39±0.08 | 2.92±0.09 | 2.47±0.01$^{a}$ | 16.5±0.5$^{e}$ | 58.5±2.4 | 13.7±0.5 | 67.9±1.5$^{abc}$ | 839.9±14.7 | 212.3±10.8$^{cd}$ |
| | Med | 5.25±0.07 | 3.07±0.08 | 2.18±0.18$^{bc}$ | 17.5±0.7$^{cde}$ | 56.1±1.5 | 12.6±0.5 | 59.0±1.9$^{de}$ | 807.9±18.9 | 231.3±4.9$^{bc}$ |
| | High | 5.06±0.15 | 2.75±0.07 | 2.31±0.10$^{abc}$ | 21.6±0.6$^{ab}$ | 62.5±1.0 | 13.0±1.3 | 64.5±2.1$^{bcd}$ | 822.5±16.3 | 249.0±7.5$^{a}$ |
| Med | Low | 5.38±0.17 | 2.92±0.09 | 2.46±0.03$^{a}$ | 16.9±0.9$^{de}$ | 59.8±2.3 | 13.9±1.3 | 57.1±2.6$^{e}$ | 733.6±29.4 | 241.3±1.5$^{ab}$ |
| | Med | 5.40±0.27 | 2.91±0.08 | 2.49±0.10$^{a}$ | 20.3±0.8$^{abc}$ | 57.2±2.5 | 16.5±1.2 | 69.0±2.4$^{ab}$ | 750.2±49.2 | 204.0±9.2$^{cd}$ |
| | High | 5.01±0.17 | 2.89±0.17 | 2.12±0.01$^{c}$ | 18.7±2.4$^{cde}$ | 57.0±5.0 | 12.2±0.9 | 62.5±3.7$^{bcde}$ | 761.5±65.1 | 199.7±3.7$^{cd}$ |
| High | Low | 5.29±0.01 | 2.94±0.08 | 2.34±0.11$^{abc}$ | 20.1±0.1$^{bc}$ | 56.7±0.7 | 15.2±1.0 | 68.6±1.3$^{ab}$ | 774.2±25.4 | 258.0±9.2$^{a}$ |
| | Med | 5.22±0.09 | 2.83±0.07 | 2.39±0.02$^{ab}$ | 23.2±0.1$^{a}$ | 61.7±1.1 | 16.9±0.6 | 72.2±1.3$^{a}$ | 759.7±27.1 | 200.0±6.9$^{cd}$ |
| | High | 5.32±0.08 | 3.15±0.10 | 2.17±0.05$^{bc}$ | 19.5±0.8$^{bcd}$ | 61.5±2.7 | 14.6±0.2 | 61.7±2.4$^{cde}$ | 813.1±24.4 | 198.7±4.9$^{cd}$ |
| Sign. | | NS | NS | 0.05 | 0.05 | NS | NS | 0.05 | NS | 0.05 |

a,b,c,d,e,f : means in the same column bearing different superscript are significantly different ( $P \leq 0.05$ ).

**Table 5** : Effect of dietary metabolizable energy and crude protein levels on fertility and hatchability percentages of Sudani ducks .

| Traits / Main effects | | Hatchability traits, % | |
|---|---|---|---|
| | | **Fertility** | **Hatch. of fertile egg** |
| **Metabolizable energy level (ME)** | | | |
| Low | | 90.37 ± 1.90 | 73.46 ±3.19 |
| Medium | | 92.89 ±2.11 | 73.65 ±2.48 |
| High | | 93.22 ±1.63 | 74.40 ±2.79 |
| Significance | | N.S | N.S |
| **Crude protein level (CP)** | | | |
| Low | | 90.66 ± 1.71 | 72.44±3.56 |
| Medium | | 92.43 ± 1.73 | 74.45±2.19 |
| High | | 93.39 ± 2.20 | 74.63±2.28 |
| Significance | | N.S | N.S |
| **Interactions** | | | |
| **ME** | **CP** | | |
| Low | Low | 89.65± 4.71 | 72.00 ±8.39 |
| | Med. | 89.36 ± 2.80 | 73.98 ±5.28 |
| | High | 92.11± 2.53 | 74.41 ±4.97 |
| Med | Low | 92.70 ± 1.42 | 73.02 ±6.66 |
| | Med | 92.27 ± 2.74 | 73.41 ±4.19 |
| | High | 93.70 ± 4.52 | 74.51 ±2.33 |
| High | Low | 89.64 ± 2.90 | 72.30 ±5.94 |
| | Med | 95.67 ± 1.46 | 75.93 ±5.85 |
| | High | 94.35 ± 2.80 | 74.97 ±3.39 |
| Significance | | NS | NS |

a,b,c,d,e :means in the same column bearing different superscript are significantly different ( $P \leq 0.05$ ).

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## الملخـــص العربـــي

## دراسة مقارنة لصفات جودة السائل المنوى والقدرة الاخصابية لذكور البط السودانى المغذاة على علائق مختلفة الطاقة والبروتين

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أجريت هذة الدراسة لبحث تأثير استخدام مستويات مختلفة من الطاقة والبروتين (٣x٣) فى تغذية ذكور البط السودانى على صفات السائل المنوى والقدرة الاخصابية لها. حيث استخدم فيها عدد **٥٤** ذكر بط من سلالة البط السودانى المحلية عند عمر **٣٢** أسبوع كما تم استخدام عدد **١٨٩** أنثى أيضا لتقييم القدرة الاخصابية للذكور. حيث تم وزن و تقسيم البط من كلا الجنسين إلى تسع مجموعات تجريبية بكل منها ثلاث مكررات متساوية ، وتم تكوين العلائق التجريبية المستخدمة بحيث احتوت على ثلاث مستويات مختلفة من الطاقة هى **٢٧٥٠** (منخفض)، **٢٨٥٠** (متوسط)، **٢٩٥٠** (عالى) كيلو كالورى /كجم عليقة وبكل مستوى منها ثلاث مستويات مختلفة من البروتين الخام هى **١٥** (منخفض) ، **١٧** (متوسط) ، **١٩**% (عالى) وتم تغذية الطيورالتجريبية عليها وتم تدريب الذكور على جمع السائل المنوى صناعيا. تم جمع عينات السائل المنوى ثم تلتها مباشرة عينات الدم فرديا لكل ذكر لتقييم صفات السائل المنوى وكذلك لتقدير بعض محتويات بلازما السائل المنوى والدم من البروتين الكلى والالبيومين والجلوبيولين وانزيمات الترانس أمينيز وإنزيم الفوسفاتيز الحامضي والقاعدي (AST,ALT, Acid and Alkaline phosphatase) والليبيدات الكلية والكوليسترول، وتم اجراء عملية تلقيح اصطناعى للإناث بالسائل المنوى للذكور الخاصة بكل مجموعة بمعدل ثلاث مرات فى الأسبوع الأول ثم مرة كل ثلاثة أيام اعتبارا من الأسبوع الثانى ولمدة ستة أسابيع بجرعة **٠,٠٥** ملى لكل بطة ثم جمع البيض الناتج بعد الاسبوع الثانى من فترة التلقيح الاصطناعى حتى نهاية التجربة وتم تفريخه من خلال ثلاث تفريخات وذلك لتقييم القدرة الاخصابية للذكور بتقدير نسبتى الخصوبة والفقس له.

**وكانت النتائج كالآتي** :

لوحظت زيادة معنوية فى حجم االقذفة وتركيز الإسبرمات والحركة التقدمية لها للذكور التى تغذت على المستوى الأعلى من الطاقة والبروتين . بينما انخفضت معنويا نسبة الحيوانات المنوية المشوهه الكلية و الميتة والملتفة الذيل والملتصقة وكذلك نسبة الحيوانات المنوية الملتفة الذيل الى الحيوانات المنوية المشوهه معنويا بالمقارنة بتلك المغذاة على المستوى المنخفض من الطاقة. كما لوحظ انخفاض معنوي فى نسبة الحيوانات المنوية الشاذة فقط بزيادة نسبة البروتين بالعليقة.

لوحظ ارتفاع معنوي فى محتوى بلازما السائل المنوى من إنزيم الفوسفاتيز الحامضى والليبيدات الكلية للذكور المغذاة على العليقة عالية الطاقة مقارنة بتلك المغذاة على العليقة المنخفضة منها. كما لوحظ انخفاض معنويا فى محتوى كل من الألبيومين و ALT و AST للذكور المغذاة على العليقة عالية البروتين مقارنة بتلك المغذاة على العليقة المتوسطة منه بينما كان الانخفاض غير معنويا فى إنزيم الفوسفاتيز الحامضى فقط .

لوحظ ارتفاع معنوي فى محتوى بلازما الدم من إنزيم الفوسفاتيز الحامضى وانزيمات الكبد AST, ALT للذكور المغذاة على العليقة عالية الطاقة بينما انخفضت الليبيدات الكلية والكولسترول الكلى بدون معنوية مقارنة بتلك المغذاة على العليقة منخفضة الطاقة . كما لوحظ انخفاض معنويا فى محتوى بلازما دم الذكور من الجلوبيولين والكولسترول الكلى بينما ارتفع معنويا محتواه من إنزيم الفوسفاتيز الحامضى بالتغذية على العليقة عالية البروتين مقارنة بالعليقة المنخفضة منه. كما لوحظ تحسنا غير معنويا فى نسبتى الخصوبة والفقس بزيادة مستويات كل من الطاقة والبروتين فى العليقة حيث سجلت أفضل القيم لهم بالتداخل بين مستوى الطاقة الأعلى مع مستوى البروتين العالى والمتوسط فى العليقة.

**وقد خلصت النتائج الى إمكانية تحسين صفات السائل المنوى والقدرة الاخصابية لذكور البط السودانى بإستخدام عليقة تحتوى على ٢٩٥٠ كيلو كالورى طاقة ممثلة /كجم وبروتين خام ١٧-١٩% بدون أى تأثير سلبى على صفات الخصوبة والفقس لبيض التفريخ.**