Egypt. Poult. Sci. Vol. (42) (I): (121-136) (2022) **(2203-1200)**

Egyptian Poultry Science Journal

http://www.epsj.journals.ekb.eg/

ISSN: 1110-5623 (Print) – 2090-0570 (Online

INFLUENCE OF DIETARY ENERGY AND PROTEIN THROUGHOUT GROWTH PHASE ON SUBSEQUENTLY EGG PRODUCTION AND HATCHING FEATURES OF SUDANI DUCKS

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Received: 13/03/2022 Accepted: 04 /04/2022

ABSTRACT: A total of 459 hatched Sudani ducklings (324 females + 135 male) were taken, weighed and distributed into 9 experimental categories (36 female + 15 male) to examine the effect of metabolizable energy (ME) and crud protein (CP) levels in rearing diets on subsequently laying performance (25-41 wk of age) and hatching traits. The dietary ME levels in the starter period were 2600 (ME1), 2800 (ME2) and 3000 (ME3) kcal /kg, each contained crude protein level of 18 (CP1), 20 (CP2) and 22 (CP3) % from hatch up to 8 weeks of age , then followed by grower diets contained 2550, 2650, and 2750 kcal of ME/kg, each contained of 12, 14 and 16 % CP , respectively, from 9 up to 20 wks of age, after that one layer diet was provided to all experimental categories at 21 up to 41 wks.

Results showed that ducks body weight (BW) at 20 wks-old was ($P < 0.01$) elevated by rising ME in the diet through rearing phase, while higher BW was occurred by feeding medium CP level. Moreover, feed conversion ratio was ($P < 0.01$) improved by elevating both ME and CP level in diet from hatch up to 20 wks-old. Ducks age at 1st egg, 25.0% and peak of egg production was ($P < 0.05$) decreased as a result of feeding diet contained ME3 during rearing period, while it was decreased by feeding both CP2 and CP3 than those fed CP1in the diet. Subsequent laying measurements (egg number and mass, feed conversion) were ($P < 0.01$) enhanced by ME3 compared with ME2 and ME1 groups, while these improvements were occurred with CP2 only throughout the tested period (25-41 wks-old). The best values of laying parameters were occurred with ME3 and CP2 interaction. All studied hatching features were ($P > 0.05$) influenced by varied CP levels and the interaction between ME and CP, while different ME in diet had significant effect on fertility and embryonic mortality percentages. The results cleared that using high ME (3000 kcal/kg) with medium CP (20%) in starter diet followed by ME (2750 kcal/kg) with CP (14%) in grower diet throughout rearing phase of Sudani ducks, which should be followed by a layer diet containing 2850 Kcal, ME / kg with 17 % CP could be decreased the ducks age at sexual maturity (at first egg laid), enhanced the subsequent egg production performance and improved hatching traits.

Key words: Sudani ducks, energy, protein, laying performance, hatching traits.

INTRODUCTION

Knowledge of the nutritional requirement at various stages of production will lead to maximum biological and economic efficiency in the use of feed resources. The high cost of feed input for poultry farming means that aside from health related issues, feed management is the key profit index in poultry production. One way out of the high cost of feed in poultry production is the development of dietary formulations which allow to use of commercial rations for feeding of poultry stems (Achi et al., 2007). Sudani ducks breeder may have different nutritional requirements compared to other ducks breeders. Duckling's nutrition in early stages of age is very necessary for subsequently egg production and quality. Because there is a direct relation among the pullet's growth through rearing phase and their reproductive system development, which effect on subsequent egg performance during the production phase (Hudson et al., 2000).

Dietary energy (DE) and crude protein (CP) are the two expensive and essential nutrients in ducks diets. Decreased feed intake could have a big impact on cost of production because it plays a significant role in production cost. With the markedly increase in feed ingredient prices during last few years, it is more important for producers to get information that would allow them to optimize DE and CP use (Babiker and Abbas, 2009). With the commercial eggs production of poultry, which facing high feed costs, could be lowering protein and energy consumption for pullets during rearing period could help to reduce costs (Anderson, 2010). Body weight is an important measurement for poultry pullet's development, because it has positive effect related to age at sexual maturity as well as egg weight during the egg production phase (Keshavarz, 1995).

Many research's proposed that, the importance to begin controlling of nutrients poultry diet at an earlier age of growing phase to enhance body weight at maturity age and consequent the early egg size (Keshavarz and Nakajima, 1995 ; Hudson et al., 2000). The information pertaining to the effect of dietary levels of energy and protein during the growing period on pullet's growth and subsequent production performance of Sudani ducks very infrequent. Therefore, this investigation amid to assess the diets energy and protein effects throughout rearing phase on subsequent egg production and hatching features for local Sudani ducks.

MATERIALS AND METHODS

Birds and management:-

This study was carried out at El – Serw Water Fowl Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. A total of 459 hatched Sudani ducklings (324 females + 135 male), were taken, weighed and distributed into 9 experimental groups (36 female + 15 male ducklings for each) to investigate the effect of varying energy and crud protein levels in the diets during rearing phase on subsequently laying performance of ducks. According to the treatment groups, the ducklings were arranged in a factorial (3x3) design (three energy levels and three protein levels). Each treatment group was consisted of three replicates of 12 female plus 5 male ducklings each. Ducklings

were reared under similar hygienic, environmental and managerial conditions.

Experimental diets:-

During rearing period, nine starter and grower diets were formulated to contain the studied energy and protein levels. The studied dietary treatments fed from hatch up to 8 week of age the starter diets that contained 2600 (ME_1), 2800 (ME_2) and 3000 (ME_3) kcal ME/kg, each contained of 18 (CP_1), 20 (CP_2), or 22 (CP_3) % CP (Table 1), then from 9 - 20 wks of age (grower period), the starter diets followed by the diets contained 2550, 2650 and 2750 kcal ME/kg, each contained of 12, 14 and 16 % CP (Table 2). During laying period (21 wks of age up to the end of experiment), one layer diet was used for all experimental groups (Table 3).

Data collection and estimated parameters:

1. During rearing period : Live body weight (LBW) and feed consumption (FC) of ducklings were recorded from hatch up to 20 wks of age, while, feed conversion ratio (FCR) were calculated during the whole experimental period (0-20 wks of age) .

2. During laying period: Age (day) of ducks was recorded at lay the first egg, 25% and the peak of eggs production. Feed consumption (FC), egg number (EN) and egg mass (EM) per duck of each replicate for all treatments was recorded and calculated during the experimental period from 25-41 weeks of age. Also, laying rate and feed conversion ratio for egg production were calculated during the same period.

3. Hatching traits: Hatchability traits were measured by collecting eggs for incubation through the experimental period. Fertile eggs and early embryonic mortality were counted at the 10^{th} day of incubation. Then, hatched ducklings and late embryonic mortality (un-hatched eggs with live or dead embryos and dead hatched ducklings) were counted at the end of incubation period, then, hatchability and embryonic mortality percentages were calculated.

4. Statistical analysis: Data obtained were statistically analyzed using the General linear model of SAS (2004). In this study, the model used was 3x3 factorial design. Considering the metabolizabile energy (ME) and crud protein level (CP) as the main effects, the model used was:

$Yijk = \mu + Ti + Rj + (TR)ij + eijk$ where :

Yijk = An observation ;

μ = Overall mean ;

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

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

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

eijk = experimental random error.

Differences among treatment means were estimated by Duncan's multiple range test *(*Duncan, 1955*).*

RESULTS AND DISCUSSION

Rearing period parameters:

Live body weight:-

Significant effects were detected among Sudani ducklings by treatment through rearing phase on growth traits (Table 4). Live body weight (LBW) was significantly enhanced by feeding ME_2 and ME_3 diets as compared to those fed ME_1 diet, whereas, ducklings fed CP_2 diet had significantly

higher LBW than those fed CP_1 and CP_3 at 20 wks-old. Also, LBW recorded the highest value for ducklings fed diet contained ME_2 or ME_3 with CP_2 as compared with other interactions at 20 wks of age. These observations are similar to those observed by Fan et al. (2008) and Awad et al. (2014) who reported that LBW of Sudani ducklings recorded the best value by feeding medium or high- ME (2800 or 3000 kcal) in starter and (2650 or 2750 kcal/kg) grower diet with medium-CP (20% followed by 14%) than other interaction at rearing period (20 wks -old).

Feed consumption:-

Feed consumption per duckling was ($P<0.01$) attenuated by elevating diet ME through the experimental period for ducklings fed ME_2 and ME_3 diet than those fed ME_1, (Table 4), while it was insignificantly decreased by feeding CP_2 or CP_3 than those fed CP_1 diet . Feed consumption per duckling was not significantly affected by the interaction between ME and CP during the experimental period (20 wks of age). The lowest value was recorded by feeding ME3 with CP_3 than other interactions during the overall experimental period. These findings could attributed to the requirement from dietary ME for growing ducklings that depend on the amount of feed consumed to meet changeable demands form calories (Nahashon et al., 2005). This result is in close agreement with Kout Elkloub et al. (2010) and Awad et al. (2014) who explained that the lowest FC values of Domyati or Sudani ducklings were recorded by feeding high-ME level with medium or high- CP levels in starter and grower diet during rearing period.

Feed conversion ratio (FCR):-

Feed conversion ratio was significantly improved for ducklings fed ME_2 and ME_3 than those fed ME_1 during the experimental period (Table 4). Ducklings FCR was improved by feeding ME_2 and ME_3 diet as compared with those fed ME_1 diet, during the experimental period (0-20 wks of age). On the other hand, it was significantly improved by 4.86 and 2.78 % of duckling fed CP_2 and CP_3 than those fed CP_1 diet, respectively during the overall experimental period. Ducklings FCR had better by feeding diet contained ME_2 or ME_3 with both CP_2 levels than other interactions (Table 4). These observations are in the same line with Awad et al. (2014) who reported that FCR of Sudani ducklings recorded the best value by feeding medium or high- ME (2800 or 3000 kcal) in starter and (2650 or 2750 kcal/kg) grower diet with medium-CP (20% followed by 14%) than other interaction at rearing period (20 wks-old).

Laying performance of Sudani ducks:

Results in Table (5) revealed a significant differences among experimental groups in the ducks age at the 1st egg , 25 % and the peak of egg production as a result of fed varied ME and CP diets of Sudani ducks during rearing phase. First egg was laid earlier by 3 days for ducks reared on diet contained ME3 and 5 days by fed CP3 diet as compared with those reared on other levels ME or CP in the diet. However, ducks age was decreased by approximately 2-3 days for ducks reared on ME3 or CP3

diet than those fed other ME or CP levels at the egg production level recorded 25 %. Interaction among ME and CP recorded a significant effects in ducks age at the 1st egg only. Ducks age at the 1st egg was recorded the lowest value due to feeding ME3 with different CP levels in the diet during rearing period (Table 5). Pullets fed high-ME diet had rapid sexual maturity than other pullets fed low-ME diet. This result possibly due to specific hormonal and metabolic changes that were associated with faster changes in BW lipid and protein content. This results are in the same line with Sunder et al. (2008) who reported that higher energy balances in grower diet resulted in early timing of puberty, possibly through maturation of endocrine system and elevation of LH and FSH concentration.

Egg number and laying rate:

Both subsequent egg number and laying rate were affected ($P \leq 0.01$) by feeding varied ME and CP diets at rearing phase (Table 5). Egg number (EN) per duck was higher ($P \leq 0.01$) by 10.02 and 5.56% for ducks reared on diet contained ME_3 than those reared on ME_1 and ME_2 diets, respectively, however, it significantly improved by 11.48 and 11.79% for ducks reared on diet contained CP_2 than those fed CP_1 and CP_3 diets during rearing period, respectively during the experimental period (25-41 wks-old). Interaction among ME and CP had ($P \leq 0.01$) effects on EN during the experimental period. Ducks fed diets contained ME_3 followed by ME_2 with CP_2 level during rearing period recorded the best egg number per duck (54.0 & 47.26) during the period of 25-41 wks of age of Sudani laying ducks. In the same trend, laying rate % was significantly improved by feeding diet contained ME_3 followed ME_2 with CP_2 level during rearing period recorded the best egg number per duck (54.0 & 47.26) during the period of 25-41 wks-old. This findings could attributed to Sudani ducks had a specific variation than other ducks breeds likes its low amount of feed consumption. It has been well established that feeding high-ME diets resulted in multiple ovulations and erratic oviposition, which were perhaps responsible for the variation in egg production among different groups in our study. These results are agreed with Joseph et al. (2000) who found that increased protein intake during the prebreeder and early breeder periods increased egg production and egg size. Hudson *et al.* (2000) reported that providing higher crude protein intakes at an early age may improve subsequent egg production for broiler breeders. Nahashon et al. (2007) who found the subsequent egg production/ hen was enhanced by the elevation of diet protein up 22 to 24% than 20% through the 0-8 wk of age. Babiker et al. (2010) reported that laying rate per hen was significantly influenced by different protein and metabolizable energy levels in the diet during rearing period, they found that birds fed starter diet with 20%CP plus 3200 kcal ME/kg, followed grower diet with 17%CP plus 3250 kcal ME/kg resulted a best egg production. In contrary, Keshavarz (1998) found that laying rat of egg production not changed by various protein levels in the diet during the growing phase.

Egg mass:

Significant differences were observed among the experimental groups in egg

mass (EM) per duck during the experimental period due to rearing ducks on varied ME and CP diets (Table 5). Subsequent egg mass per duck was significantly improved by 10.55 and 6.0% for ducks fed diet contained ME_3 than those fed ME_1 an ME_2 diet, respectively during the rearing period. Moreover, EM was significantly higher by 12.05 and 11.31% for ducks fed diet contained CP2 than those fed CP1 and CP3 diet during rearing period, respectively. Egg mass was significantly influenced by ME and CP interaction during the experimental period. Ducks fed ME_3 followed ME_2 with CP_2 diets during rearing phase recorded the best subsequent egg mass per duck (3616.0 & 3177.0 g) during the period of 25-41 wks-old of Sudani laying ducks. This result may be due to Sudani ducks had a shorter laying sequences , higher egg production and better feed conversion efficiency to egg production. This findings agreed with Babiker et al. (2011) who explained that feeding higher dietary protein levels (20 and 22%) for the birds during the growing period had higher egg mass than those fed the lowest protein level (18%), although, egg weight and egg mass were not affected by varied dietary energy levels fed to the birds during the growing period.

Feed consumption:

Feed consumption (FC) was significantly affected during the experimental period due to different CP diets and ME and CP interaction, while it not affected by ME (Table 5). Ducks reared on different ME diets during rearing period consumed approximately similar amount of feed during experimental laying period (25-41 wks of age). On the other hand, FC per duck was significantly decreased by feeding diet contained CP3 level than those fed CP1 and CP2 levels during the experimental laying period (25-41 wks of age), it was significantly lower by 7.64 and 12.65%, respectively. Interaction among ME and CP recorded a significant effect in FC during the studied period. Ducks fed diet contained ME_3 followed ME_2 with CP_2 level during rearing period recorded the lowest FC per duck (15.54 & 14.99 kg) during the period of 25-41 wks of age of Sudani laying ducks. In the present study, the lack of difference in feed consumption between ducks fed different ME levels in diet may be due to the narrow range of the three energy levels, while, the high protein levels in diet which resulted in a significant decrease in duck feed consumption, probably may be due to the protein requirement had been covered with the lowest tested levels (CP1 or CP2). This findings agreed with Marc and Coon (2006) who displayed the less total feed consumed without significant for hens fed higher early protein intakes through the rearing period than control birds.

Feed conversion ratio:

Feed conversion ratio (FCR) during subsequent laying period was ($P < 0.05$) affected by feeding varying energy and protein diet during rearing period (Table 5). Feed conversion ratio (FCR) was significantly improved for ducks reared on ME3 diet than those reared on ME1 diet during rearing period through subsequent laying period (25-41 wks of age), it improved by 8.29%. The same trend was occurred by using CP3 than CP1diets at the same period, while the interaction among ME and CP resulted in a significant effect

in FC during the studied period. Ducks fed diet contained ME_3 with CP_2 level during rearing period recorded the best FCR (5.24) during the period of 25-41 wks-old of Sudani laying ducks. These results may be attributed to the different amounts of feed consumed and egg production. This findings agreed with Marc and Coon (2006) displayed the best feed conversions without significant for hens fed higher early protein intakes through the rearing period

Hatching traits:

Results of Table 6 shows some hatching traits for eggs of Sudani ducks reared on diets varied in ME and CP during rearing period. Fertility % was significantly improved by 3.02 and 4.82 % for eggs of ducks reared on ME2 and ME3 than those reared on ME1 diet during rearing period, respectively, while it was insignificantly improved by increasing CP level in the diet. In the current study, fertility % was not affected by different dietary protein levels during rearing. This is similar with Van Emous et al. (2013 &2015) who reported that feeding different dietary protein level during rearing period not effect on egg hatching traits. In contrary, Walsh and Brake (1997& 1999) found that a low CP intake during rearing could reduce fertility during lay.

Hatchability of fertile eggs was insignificantly improved by increasing both ME and CP level in the diet during rearing period. Both early and late embryonic mortality % were significantly affected due ME level, while they not affected due to CP.

Total embryonic mortality was insignificantly attenuated by elevating dietary ME and CP level.

Interaction among ME and CP had no significant effect on all studied hatching traits, while the best fertility value was occurred by using ME3 with CP2 or CP3 diet but the best value of hatchability and total embryonic mortality was occurred by ME2 with CP3 .

IN CONCLUSION

The results of this study concluded that feeding starter diet contained 3000 kcal (ME_3)/kg with 20% CP followed by grower diet that 2750 kcal/ kg with 14%CP during rearing period, which should be followed by a layer diet containing 2850 Kcal, ME / kg with 17 % CP could decrease the ducks age at sexual maturity (at first egg laid), improve the subsequent laying performance and hatching traits of Sudani ducks.

Table (1): Composition and calculated analysis of starter diets (0-8 wks) .

Ingredients %	Energy level (Kcal ME/kg)								
	ME_1			ME_2			ME_3		
	Protein level (%)								
	CP_1	CP_2	CP_3	CP_1	CP_2	CP_3	CP_1	CP_2	CP_3
Yellow corn	54.85	51.15	46.75	63.85	59.35	54.55	70.15	66.75	62.55
Soy bean meal(44%)	23.80	26.50	26.30	26.10	26.10	25.80	18.30	21.95	23.15
Gluten meal (60%)	0.00	2.10	5.80	0.00	3.60	7.70	5.70	7.25	10.25
Wheat bran	17.30	16.20	17.10	6.00	6.90	7.90	1.80	0.00	0.00
Di-calcium phosphate	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Limestone	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Vit & Min. premix *	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Salt (NaCl)	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
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 **									
CP %	18.02	20.03	22.00	18.03	20.02	22.02	18.01	20.00	22.02
ME (Kcal / kg)	2603	2603	2602	2805	2801	2801	3001	3002	3000
Calcium (%)	1.05	1.05	1.05	1.05	1.04	1.04	1.01	1.02	1.02
Av. Phosphorus (%)	0.46	0.47	0.47	0.46	0.46	0.46	0.44	0.44	0.44

*Each 3 kg of the Vit and Min. premix 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)

ME= metabolizable energy , CP= crude protein

Table (2): Composition and calculated analysis of grower diets (9-20 wks).

Ingredients %	Energy level (Kcal ME/kg)								
	ME_1			ME_2			ME_3		
	Protein level (%)								
	CP_1	CP_2	CP_3	CP_1	CP_2	CP_3	CP_1	CP_2	CP_3
Yellow corn	61.50	58.40	55.40	65.70	62.80	60.00	70.10	67.20	64.30
Soy bean meal(44%)	4.50	10.80	17.10	5.50	11.90	18.20	6.60	13.00	19.20
Wheat bran	30.00	26.80	23.50	24.80	21.30	17.80	19.30	15.80	12.50
Di-calcium phosphate	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Limestone	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
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 **									
CP %	12.09	14.08	16.08	12.08	14.09	16.08	12.08	14.09	16.06
ME (Kcal / kg)	2567	2560	2555	2661	2660	2659	2760	2758	2755
Calcium (%)	1.03	1.04	1.05	1.02	1.03	1.04	1.02	1.03	1.05
Av. phosphorus (%)	0.43	0.43	0.44	0.42	0.42	0.43	0.41	0.42	0.43

*Each 3 kg of the Vit and Min. premix 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).

ME= metabolizable energy , CP= crude protein

Table (3): Composition and calculated analysis of the basal diet (21 – 42wks)

Ingredients	**%**
Yellow corn	67.1
Soy bean meal (44 %)	17.75
Corn gluten (60 %)	5.35
Di-calcium phosphate	1.70
Limestone	7.30
Vit & Min. premix [1]	0.30
NaCl	0.30
DL- Methionine (99%)	0.20
Total	**100**
Calculated Analysis [2]	
Crude protein %	17.01
ME (Kcal / kg)	2851
Ca. %	3.21
Av. Phosph.%	0.43

1- Each 3kg of Vit .and Min. premix contains 100 million IUVit A;2 million IU Vit.D3;10 g Vit.E; 1 g Vit.K_3 ; 1 g Vit B1; 5 g Vit B2 ;10 mg Vit.B12 ; 1.5 g Vit B6; 30 g Niacin ;10 g Pantothenic acid ;1g Folic acid;50 mg Biotin ; 300 g Choline chloride; 50 g Zinc; 4 g Copper; 0.3 g Iodine ; 30 g Iron; 0.1 g Selenium; 60g Manganese ;0.1 g Cobalt; and carrier $CaCO_3$ to 3000 g .
2- According to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001).

Table (4): Effect of dietary energy and protein levels on some growth performance traits of Sudani ducklings from hatch date up to 20 wks of age.

Parameters / Main effects		Live body weight , g		Feed consumption kg	Feed conversion ratio
		At hatch	At 20 wks	0-20 wks	0-20 wks
Metabolizable energy level (ME)					
ME 1		45.0	2027.0 ^{b}	11883.0 ^{a}	6.00 ^{a}
ME 2		45.0	2083.0 ^{a}	11133.0 ^{b}	5.48 ^{b}
ME 3		45.4	2108.0 ^{a}	11041.0 ^{b}	5.35 ^{b}
Pooled SEM		0.4	15.5	63.8	0.05
Significance		NS	**	**	**
Crud Protein level (CP)					
CP 1		45.5	2038.0 ^{b}	11445.0	5.76 ^{a}
CP 2		44.9	2122.0 ^{a}	11347.0	5.48 ^{b}
CP 3		45.0	2059.0 ^{b}	11266.0	5.60 ^{b}
Pooled SEM		0.4	15.5	63.8	0.05
Significance		NS	**	NS	**
Interactions					
ME	**CP**				
ME 1	**CP 1**	45.8	1987.0 ^{b}	11973.0	6.17 ^{a}
	CP 2	44.2	1999.0 ^{b}	11774.0	6.02 ^{a}
	CP 3	45.0	2093.0 ^{ab}	11905.0	5.81 ^{ab}
ME 2	**CP 1**	45.5	2018.0 ^{b}	11085.0	5.63 ^{bc}
	CP 2	45.0	2219.0 ^{a}	11196.0	5.15 ^{d}
	CP 3	44.5	2012.0 ^{b}	11116.0	5.65 ^{ab}
ME 3	**CP 1**	45.4	2108.0 ^{ab}	11277.0	5.47 ^{bc}
	CP 2	45.5	2146.0 ^{a}	11072.0	5.27 ^{cd}
	CP 3	45.4	2070.0 ^{ab}	10777.0	5.32 ^{cd}
Pooled SEM		0.7	26.9	110.5	0.09
Significance		NS	**	NS	**

a,b,c,d :means in the same column within each item bearing different superscript are significantly different ($P \leq 0.05$). NS = not significant , SEM = standard error mean

Table (5): Effect of feeding different energy and protein levels throughout rearing phase on subsequent laying performance of Sudani ducks (25-41 wks-old).

Parameters / Main effects		Age (day)			Egg No. / duck	Laying rate، %	Egg mass, g / duck	FC, Kg / duck	FCR
		1st egg	25% EP	Peak EP					
Metabolizable energy level (ME)									
ME 1		165.56 a	179.89 ab	206.56 a	42.11 b	37.60 b	2818.8 b	16.55	5.91 a
ME 2		165.89 a	180.33 a	204.56 ab	43.89 b	39.19 b	2939.8 b	16.78	5.72 ab
ME 3		162.78 b	177.33 b	202.33 b	46.33 a	41.36 a	3116.2 a	16.82	5.42 b
Pooled SEM		0.90	0.88	1.11	0.70	0.62	47.3	0.28	0.10
Significance		*	*	*	**	**	**	NS	*
Crud Protein level (CP)									
CP 1		167.78 a	181.78 a	206.00	42.52 b	37.97 b	2837.0 b	16.83 a	5.95 a
CP 2		163.78 b	178.44 b	203.11	47.40 a	42.33 a	3179.0 a	17.79 a	5.64 ab
CP 3		162.67 b	177.33 b	204.3	42.40 b	37.85 b	2856.0 b	15.54 b	5.46 b
Pooled SEM		0.90	0.88	1.11	0.70	0.62	47.3	0.28	0.10
Significance		**	**	NS	**	**	**	**	*
Interactions									
ME	**CP**								
ME 1	**CP 1**	171.00 a	184.33	209.67	39.86 c	35.59 c	2642.0 d	16.44 bc	6.22 a
	CP 2	164.33 ab	178.67	204.33	40.95 bc	36.56 bc	2744.0 cd	17.12 abc	6.24 a
	CP 3	161.33 b	176.67	205.67	45.52 bc	40.64 bc	3067.0 bc	16.10 bc	5.26 b
ME 2	**CP 1**	169.67 a	183.00	206.00	44.96 bc	40.14 bc	2973.0 bcd	18.07 a	6.09 a
	CP 2	163.33 b	179.33	202.67	47.26 b	42.20 b	3177.0 b	17.30 ab	5.45 ab
	CP 3	164.67 ab	178.67	205.00	39.45 c	35.22 c	2665.0 d	14.99 c	5.63 ab
ME 3	**CP 1**	162.67 b	178.00	202.33	42.76 bc	38.18 bc	2894.0 bcd	15.98 bc	5.53 ab
	CP 2	163.67 b	177.33	202.33	54.00 a	48.21 a	3616.0 a	18.95 a	5.24 b
	CP 3	162.00 b	176.67	202.33	42.22 bc	37.70 bc	2836.0 bcd	15.54 c	5.48 ab
Pooled SEM		1.56	1.52	1.93	1.21	1.08	81.9	0.45	0.18
Significance		*	NS	NS	**	**	**	**	*

a,b :means in the same column within each item bearing different superscript are significantly different ($P \leq 0.05$). NS = not significant SEM = standard error mean.

Table (6): Effect of dietary energy and protein levels on hatching traits of Sudani ducks.

Main effects		Hatching parameters, %				
		Fertility	Hatch of Fertile eggs	Early EM	Late EM	Total EM
Metabolizable Energy level (ME)						
ME 1		85.01 [b]	75.43	3.02 [b]	21.55 [a]	24.57
ME 2		87.58 [a]	78.82	5.30 [a]	15.88 [b]	21.18
ME 3		89.11 [a]	79.44	3.73 [b]	16.83 [b]	20.56
Pooled SEM		0.68	1.43	0.44	1.34	1.43
Significance		**	NS	**	*	NS
Crud Protein level (CP)						
CP 1		86.31	77.90	4.15	17.95	22.10
CP 2		87.18	77.05	3.73	19.22	22.95
CP 3		88.21	78.74	4.15	17.11	21.26
Pooled SEM		0.68	1.43	0.44	1.34	1.43
Significance		NS	NS	NS	NS	NS
Interactions						
ME	**CP**					
ME 1	**CP 1**	83.44	75.94	3.32	20.74	24.06
	CP 2	85.22	75.30	2.30	22.40	24.70
	CP 3	86.36	75.05	3.43	21.52	24.95
ME 2	**CP 1**	87.64	76.31	4.41	19.28	23.69
	CP 2	86.58	77.70	5.97	16.33	22.30
	CP 3	88.51	82.45	5.51	12.04	17.55
ME 3	**CP 1**	87.84	81.44	4.74	13.82	18.56
	CP 2	89.76	78.15	2.92	18.93	21.85
	CP 3	89.75	78.73	3.53	17.74	21.27
Pooled SEM		1.18	2.48	0.77	2.32	2.48
Significance		NS	NS	NS	NS	NS

a,b :means in the same column within each item bearing different superscript are significantly different ($P \leq 0.05$). SEM = standard error mean; EM = embryonic mortality
NS = not significant

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الملخـــص العربـــي

تأثيرالطاقة والبروتين فى العليقة خلال مرحلة النمو على أداء إنتاج البيض اللاحق وصفات التفريخ للبط السودانى

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استخدم فى الدراسة عدد ٤٥٩ كتكوت بط سودانى (٣٢٤ أنثى +١٣٥ ذكر) عمر يوم تم وزنهم و تقسيمهم إلى تسع مجاميع تجريبية وبكل مجموعة ثلاث مكررات وذلك لدراسة تأثير إستخدام علائق تحتوى على مستويات مختلفة من الطاقة والبروتين (٣x٣) فى تغذية كتاكيت البط السودانى خلال فترة النمو على إنتاج البيض اللاحق وصفات التفريخ خلال الفترة من ٢٥ – ٤١ أسبوع من العمر. تم تكوين العلائق التجريبية المستخدمة وهى العليقة البادئة فى الفترة من الفقس حتى ٨ أسابيع من العمر بحيث تحتوى على ثلاث مستويات من الطاقة هى **٢٦٠٠**(الأول) ، **٢٨٠٠** (الثاني)، **٣٠٠٠** (الثالث) كيلو كالورى / كجم وبكل مستوى منها ثلاث مستويات من البروتين هى ١٨ (الأول) ، ٢٠ (الثاني)، ٢٢ (الثالث)% ، والعليقة النامية في الفترة من ٩ – ٢٠ أسبوع من العمر وتحتوى على ثلاث مستويات من الطاقة هى **٢٥٥٠** (الأول) ، **٢٦٥٠** (الثاني)، **٢٧٥٠** (الثالث) كيلو كالورى / كجم وبكل مستوى منها ثلاث مستويات من البروتين هى **١٢** (الأول) ، **١٤** (الثاني)، **١٦**(الثالث) % وتم تقديمها للمجموعات التجريبية بنفس الترتيب خلال فترة النمو ثم قدمت العليقة البياض لجميع المعاملات خلال الفترة من ٢١ أسبوع حتى نهاية الفترة التجريبية لانتاج البيض (٢٥-٤١ أسبوع من العمر) . تم تسجيل الوزن الحي والعليقة المستهلكة خلال فترة النمو وكذلك تم تسجيل العمر عند أول بيضة و ٢٥ % إنتاج وعند قمة الآنتاج وكذلك العليقة المستهلكة وعدد ووزن البيض الناتج خلال فترة التجربة ، وتم اجراء تجربة تفريخ لتقدير نسبتى الخصوبة والفقس للبيض .

وبتحليل النتائج اتضح الآتي :

لوحظ تحسن وزن الجسم معنويا بزيادة مستوى الطاقة بالعليقة خلال فترة النمو بينما سجل مستوى البروتين الثانى أفضل وزن للجسم عند ٢٠ أسبوع من العمر. كما تحسنت الكفاءة الغذاية بزيادة مستويات الطاقة والبروتين فى العليقة خلال فترة النمو.

كما لوحظ إنخفاض عمرالبط معنويا عند وضع أول بيضة و ٢٥ % وعند قمة الإنتاج بالتغذية على العلائق التى تحتوى المستوى الأعلى من الطاقة (الثالث) خلال فترة النمو وكذلك بإستخدام المستوى المتوسط من البروتين (الثانى). كما لوحظ تحسن صفات انتاج البيض اللاحق (عدد البيض وكتلتة ومعامل التحويل الغذائى لانتاج البيض) معنويا بالتغذية على العليقة المحتوية على المستوى الثالث من الطاقة والمستوى الثانى من البروتين خلال فترة النمو. كل صفات التفريخ المدروسة لم تتأثر معنويا بمستويات البروتين المختلفة وكذلك التداخل بين مستويات الطاقة والبروتين خلال فترة النمو بينما تأثرت نسبتى الخصوبة والنفوق الجنينى المبكر والمتأخر باختلاف مستويات الطاقة. هذة النتائج تشير إلى إمكانية إستخدام العلائق المرتفعة فى الطاقة والمتوسطة فى البروتين (٣٠٠٠ كيلوكالورى /كجم مع ٢٠% بروتين خام فى العليقة البادئة ثم ٢٧٥٠ كيلو كالورى/ كجم مع ١٤% بروتين خام فى العليقة النامية) خلال فترة الرعاية والنمو مع استخدام العليقة البياض المحتوية على ٢٨٥٠ كيلوكالورى/كجم مع ١٤ % بروتين خام خلال فترة انتاج البيض يمكن أن تخفض عمر البط عند النضج الجنسى (وضع اول بيضة) و تحسن أداء إنتاج البيض اللاحق وصفات التفريخ لبيض البط السودانى.