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Assessment of Broodiness and its Influence on Production Performance and Plasma Prolactin Level in Native Chicken of the Sudan

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Abstract: This study was designed to evaluate broody behavior and its effect on some production traits and the plasma prolactin hormone levels during production, incubation and rearing periods in the native chicken of the Sudan. Two stocks of dwarf (Betwil) and bare neck chicken ecotypes constituting 270 pullets were used in this study. The experimental birds were housed in floor breeding pens individually and the exhibited characteristics of broody behavior were closely observed and recorded on daily bases. Feed intake during broody and non broody periods was recorded. The effect of chicks rearing and egg accumulation in the nest as some managerial practice on broody cycle and hence egg production were also studied. Ninety blood samples representing production, incubation and rearing stages were collected from randomly selected hens (45 for each ecotype) to evaluate prolactin hormone levels and its association with the onset of broodiness. The results indicated that 86.6% of the betwil ecotype exhibited persisted broody behavior in all the measured stages compared to 55.5% for bare neck ecotype in which the signs of broody behavior were observed to be relatively mild compared to those in betwil ecotype. Depriving hens from chicks rearing resulted in significant reduction of broody cycle days. Broodiness significantly affected feed intake and egg production. The average blood prolactin level was found to be significantly ($p<0.01$) higher in betwil than in bare neck ecotype during the incubation and rearing periods. The highest prolactin level was recorded during incubation period in both ecotypes whereas the lowest was found during rearing period. It was concluded that broodiness can be alleviated by managerial practice to improve egg production potential of the local flock.

Key words: Broodiness, production performance, plasma prolactin, native chicken, Sudan

INTRODUCTION

Native chicken possesses a natural prosperity towards early cessation of egg laying. This is due to the hen's intrinsic desire to incubate a clutch of eggs to insure survival of the species. This intrinsic desire is accompanied by behavioral and physiological state associated with maternal care of the unhatched eggs termed as incubation behavior.

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High level of circulating plasma prolactin suppresses secretion of gonadotropins, which are directly responsible for regression of the ovary, the decrease in plasma ovarian steroids and ultimately the cessation of egg production in turkey and chicken (Romanov *et al*., 2002; El-Halwani *et al*., 1980). Good layers have moderate base-line prolactin levels throughout egg production. Incubation behavior constitutes a major cause that leads to early cessation of egg laying and remains a significant source of economic loss for rural poultry keepers. Although, it's difficult to eradicate incubation behavior there are some managerial techniques and strategies used to prevent it and to improve egg production based on lowering baseline prolactin. These techniques involve; moving hens from their familiar pens to different surroundings or less comfortable area without nests, frequent collection of eggs from the nests, provision of uniform lighting system that discourages nesting in dim corners and improving slow and insufficient ventilation rate. Furthermore, a successful immunization of female turkey with synthetic chicken Vasoactive Intestinal Peptide (cVIP) resulted in increase egg production (El-Halwani *et al*., 1995; Talbot *et al*., 1991).

The Sudanese native chicken with various ecotypes (large baladi, betwil and bare neck) are known to exhibit broody behavior with different levels of intensity. El-Sheik (2001) reported that 48% of the large baladi ecotype displayed this behavior at least once. Therefore, the objectives of this study are to evaluate broodiness and its effect on egg production rate and feed intake in addition to its relationship with prolactin level secretion among different stages of production in native chicken of Sudan.

MATERIALS AND METHODS

Foundation Stocks Management

A total number of 350 pullets and cockerels comprising two ecotypes namely dwarf and bare neck were purchased from villagers in the rural community of Sudan. The dwarf chicken which locally called betwil are mainly found in the Western Sudan in the area of Nuba mountain whereas, the bare neck home land is Southern Sudan. These birds were selected according to the phenotypic characteristics. The foundation stocks were intentionally established for breeding purposes with almost equal number of birds in each ecotype. On arrival to the poultry houses of the Faculty of Animal Production, University of Khartoum the birds were randomly distributed to individual breeding pens each 100×90×80 cm. Each cockerel was randomly assigned to mate with three pullets rotationally. The birds were treated against internal and external parasites and vaccinated against new castle disease. Formulated layer feed with 17.50% crude protein and 2750 (Kcal kg^{-1}) metabolizable energy and fresh water were provided continuously.

Broody Traits Measurement

The experiment lasted for 44 weeks with the first 4 weeks considered as adaptation period. On close observation the birds were classified into broody and non broody according to the characteristic signs of broodiness as described by Romanov *et al.* (2002). This include persisting nesting, turning and retrieval of egg, clucking, aggressiveness and defense of the nest from attempts for eggs removal. Therefore, hens are defined as broody if they exhibit broody behavior while nesting. The broody traits measured included broody cycle which calculated as the number of days for the complete broody process which commences by nesting on eggs laid and ends by the first egg laid in the next reproductive cycle. The intensity of broodiness was intimately observed for the betwil and bare neck ecotypes. To test the effect of maternity on broody cycle, two trials were conducted, in the first one hens were left to rear their naturally hatched chicks until the end of the reproductive cycle, while in the second trail the hens were immediately deprived from chicks rearing after hatching. On the other hand, the effect of eggs accumulation in the nest on the onset of broody behavior and egg production was studied by intentionally leaving eggs to accumulate in the nests throughout the production period and then by immediately collecting eggs from nests as they were laid during another production period.

Prolactin Hormone Measurement

Ninety blood samples were collected from randomly selected 10 hens (5 from each ecotype) to estimate the level of prolactin hormone and it's relationship with broodiness. Nine blood samples were taken from each hen (3 from each production, incubation and rearing period). The production period was represented by samples taken at first egg laid, egg laid at the middle of the clutch and the last egg laid; whereas the incubation period was represented by samples taken at the first incubation day, middle and end of incubation. On the other hand, the rearing period was represented by the samples taken at weekly interval. The onset of incubation period is detected by the exhibition of apparent signs of broodiness and the end of this stage is determined by the hatch of the first chick whereas the hen enters the rearing period.

The blood samples were collected from the major patagial vein using 3 mL needle. Each blood sample was centrifuged and plasma was harvested in Ependorf tubes (2 mL) and stored at 4°C for 50 days waiting for analysis. About 200 µL prolactin reagent was added into the prolactin coated tubes (0.5 mL) with 50 µL of plasma, then the tubes were shaken by plate shaker for 2 h at room temperature, then the fluid was decanted and blotted on an absorbent pad. Each tube was then washed twice with 2 mL distilled water. Finally, the radioactivity was counted with gamma counter for 1 min to calculate the level of prolactin micIU mL^{-1}.

Statistical Analysis

Statistical Package for Social Science (SPSS) software version 11.5 was employed for data analysis. For prolactin analysis, Steel *et al*. (1997) was used according to the following equation:

$$Y_{ijk}= \mu \pm T_i \pm B_j \pm (T\times B)_{ij} \pm e_{ijk}$$

Where:

Y	= Single observation on the kth individual in the ith treatment and jth ecotype
μ	= Overall mean
T_j	= The random effect of the ith treatment, i = 1, 2
B_j	= The random effect of the jth breed (ecotype), j = 1, 2
$(T\times B)_{ij}$	= The interaction between the ith treatment and the jth breed (ecotype)
e	= The random error associated with single observation

RESULTS AND DISCUSSION

Broodiness

On close observation the dwarf betwil ecotypes was found to exhibit apparent and intense broody behavior, being more aggressive towards moving objects, resist attempts for removing eggs from the nest and exhibit aloud characteristic cry compared to bare neck. The results indicated that 86.67% of the betwil hens were broody while the corresponding result

Table 1: The effect of broodiness on feed intake in betwil and bare neck chicken ecotypes

Ecotypes	Treatments	Mean (g)	Min	Max	C.V
BT	During production	664.74±21.90[a]	620.90	700.16	16.91
	During broodiness	380.25±58.64[b]	284.60	457.04	22.50
BN	During production	853.54±26.24[a]	809.15	846.10	24.54
	During broodiness	409.10±43.98[b]	304.28	440.61	61.50

Means with different superscripts within each ecotype are significantly different ($p<0.01$). BT: Betwil; BN: Bare neck

Table 2: The influence of managerial practice on broody cycle and egg production rate in betwil and bare neck chicken ecotypes

Ecoypes	Treatments	Mean broody cycle (days)	Treatments	Egg production rate (%)
BT	With chicks raring	65.52±0.90[a]	Egg accumulation	28.05±1.87[a]
	Without chicks raring	40.08±1.07[b]	Frequent egg collection	49.95±3.98[b]
BN	With raring chicks	64.61±1.03[c]	Egg accumulation	37.12±2.88[c]
	Without raring chicks	39.00±1.32[d]	Frequent egg collection	58.30±12.66[d]

Means with different superscripts within columns are significantly different ($p<0.05$). BT: Betwil; BN: Bare neck

Table 3: The overall mean prolactin levels during production, incubation and rearing periods for both ecotypes

Treatment	Mean	Max	Min	C.V
During egg production	37.90±2.94[a]	43.80	32.01	41.45
During incubation	66.06±3.76[b]	73.59	58.53	30.50
During rearing	26.81±3.87[c]	34.55	19.06	48.45

Means with different superscripts are significantly different ($p<0.05$)

Table 4: Mean prolactin level during production, incubation and rearing period in betwil and bare neck ecotypes

Ecotypes	Period	Mean	Max	Min	C.V
BT	During egg production	33.93±4.24**	25.45	42.41	41.08
	During incubation	73.77±5.02**	63.73	83.80	21.98
	During rearing	29.68±4.24**	21.20	38.16	37.12
BN	During egg production	41.88±4.09**	33.68	50.07	37.51
	During incubation	58.36±5.61**	47.14	69.58	34.52
	During rearing	23.93±6.48**	10.97	36.89	54.28

**($p<0.01$). BT: Betwil; BN: Bare neck

for bare neck was 55.56%. The broody cycles were found to be 65.52±0.9 and 64.61±1,03 days in betwil and bare neck, respectively. On the other, hand the broody cycle was significantly ($p<0.05$) reduced due to depriving hens from chicks rearing. This reduction attained 38 and 40% in betwil and bare neck, respectively. Table 1, shows the effect of broodiness on feed intake there was a significant ($p<0.05$) reduction in feed intake during broody period compared to that during production period in both ecotypes. This reduction represented 43 and 52% in betwil and bare neck, respectively. The onset of broodiness was substantially delayed by frequently collecting eggs from the nest, resulting in significant increase in egg production (Table 2).

Prolactin Hormone Status Associated with Broodiness

The prolactin secretion in all domesticated chicken has a major effect on maternal behavior through its effect on the ovary by inhibiting ovulation and inducing broody behavior. Table 3 and 4 showed the overall mean prolactin levels and prolactin levels for betwil and bare neck ecotypes at three different stages (egg production, incubation and rearing). The results showed significant difference ($p<0.05$) in prolactin levels during egg production, incubation and rearing periods. The average prolactin level (micIU micL^{-1}) was highest during the incubation period (66.06±3.76) and lowest during rearing period (26.81±3.87) (Fig. 1). The prolactin curve exhibited rising trend throughout the production period to reach the maximum level at week 5 (Fig. 2). These findings are in agreement with those reported by Lighton (2001), Hessling (2007) and El-Halawani (1980). The maximum

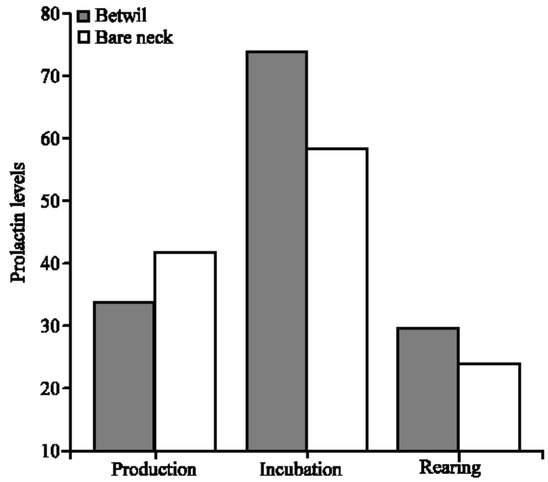

Fig. 1: Mean levels of prolcatin in three periods in two chicken ecotypes

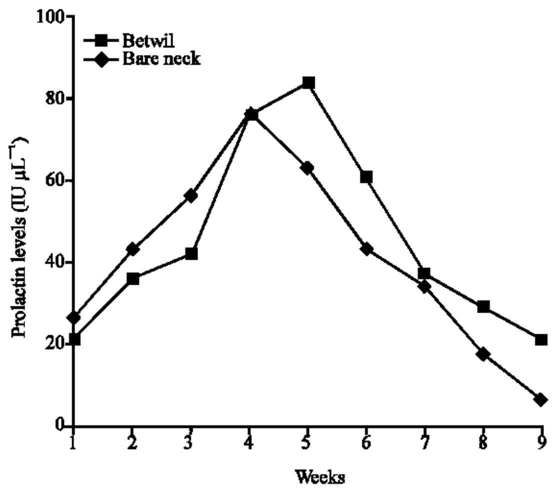

Fig. 2: Prolactin levels during production, incubation and rearing periods. Weeks 1-3: Production period, Weeks 4-6: Incubation period and Weeks 7-9: Rearing period

prolactin level was reached at the 5th week in betwil and 4th week in bare neck ecotype during the incubation period and then declined steady to reach the lowest level for both ecotypes at 9th week during the rearing period (Fig. 2). The present results indicate a strong relationship between plasma prolactin level and the onset and maintainance of incubation behavior. This finding has also been emphasized by Reddy *et al.* (2006) when he used active immunization against cProlactin which resulted in increased egg production and decreased pause days. Generally the prolactin levels at different stages show significant difference ($p<0.05$) between the two ecotypes. Prolactin level was significantly higher in betwil than that in bare neck during incubation and rearing periods, whereas the reverse was true during egg production period, this may partially explain the strong broodiness which was observed in betwil compared to that in bare neck.

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