GROWTH PERFORMANCE AND PHYSIOLOGICAL RESPONSE FOR BUFFALO CALVES UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

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Abstract

This work was carried out on 86 buffalo calves in two fattening farms .One (Farm1) in old land (village) and the other (Farm 2) in the reclaimed land (new land called El-Mrog land) in Oscor village, El-Saff city, Giza governorate. 34 calves in farm (1), divided to 19 were greater than one year (Average body weight between 230-270 kg) and 15 calves less than one year of age (Average body weight between 168-205 kg). And 52 calves in the second (Farm 2), also divided to 34 calves greater than one year (Average body weight between 191-234 kg) and 18 calves less than one year of age (Average body weight between 61-156 kg).

The present work was carried out to compare the growth performance and physiological response under two different conditions.

It was resulted that the calves in farm 1 (in the old land) were better for growth rate and physiological responses than farm 2 (reclaimed land). The buffalo calves were successful live in the reclaimed land with harsh conditions. The higher values of boy weight (BW) and average body gain (ADG) were recorded at summer than winter. Economically, prefer fattening buffalo calves over one year. Accordingly, buffalo breeding in the reclaimed land give good production.

Keywords: Average daily gain (ADG), physiological parameter, reclaimed land, buffaloes.

INTRODUCTION

Buffaloes were playing an important role in Egypt's agriculture, their populations increased markedly during the last two decades. The number of buffalo nearly 4 million heads (FAOSTAT, 2010). They more adapted at small-holder conditions. Buffalo contribute by 18 % (270000 Ton) of total meat production (1528789 Ton) (FAOSTAT, 2008) suitability of Egyptian buffalo to hot climate is achieved by morphological, anatomical and physiological characteristics (Ashour *et. al.,* 2000, 2004 and Omran 1999, 2008).

The subtropical zone is characterized by aridity, intensive insulation and high air temperature. Diurnal fluctuation in temperature are very wide, arrange of 20°C in summer is common, often reaching extremely great values even in winter. Such harsh

climate in the subtropics, at least nine month in Egypt, has direct and indirect effects on thriftiness and productive performance of the livestock (Shafie, 1989).

Omran *et. al.* (2011) found that buffalo calves with the climatic change is more adapted and any improved in feeding, housing management and employing techniques to modify environmental condition can realize alleviation of heat load on the animals during high ambient temperatures and can increase meat production from buffalo calves. Immunity of buffalo and heat tolerance increased to breeding the buffaloes under the reclaimed land.

The main objective of the present study was compare between growth performance and physiological reaction of buffaloes under two different environmental conditions (the village and reclaimed land).

MATERIALS AND METHODS

Animals, management and feeding

This work beginning at the summer and carried out on 86 buffalo calves in two fattening farms. One (Farm1) in old land (village) and the other (Farm 2) in the reclaimed land (El-Mrog land) in Oscor village, El-Saff city, Giza governorate. 34 calves in farm (1), divided to 19 were greater than one year (Average body weight between 230-270 kg) and 15 calves less than one year of age (Average body weight between 168-205 kg), And 52 calves in the second (Farm 2), also divided to 34 calves greater than one year (Average body weight between 191-234 kg) and 18 calves less than one year of age (Average body weight between 61-156 kg).

Essentially, the animal's feed was depending on concentrates in two farms. At first farm (Farm 1), the Egyptian clovers, wheat bran were provided to the animals in winter, and Drawa, Barseem hay, wheat straw, bean hulls in summer. The concentrates were gave once/day, and the roughage ad lib. Water was available once/day in the winter and twice/day in the summer. The salinity of water was 200 ppm. The animals located in the first floor in the house and in the second floor the farmer dwelling. The animals were homed in this house for boarding only and there is bulb for illumination. Throughout the day, the animals are outside behind the house, the yard is semi-open in part of the agricultural land under shed from Maize stoke.

The second farm (Farm 2) is reclaimed land area called El-Mrog land. The alfalfa clover, wheat straw and alfalfa hay were provided to the animals in winter, while in the summer, alfalfa clover, alfalfa hay, wheat straw, bean hulls. The concentrate was gave twice/day but the roughage ad lib. The water, was available twice/day and before the meal in winter and summer. The drinking water from wells,

salinity is 2500 ppm. Animals located within the close yard from clay and the roof from maize stoke above unit of wood.

Physiological responses

Each farm was visited twice a month to recorded the air temperature (AT,°C) and humidity (RH, %) by using Mercury centigrade thermometer, hair hygrometer hanging from the roof at the level of 2 meters above the animal under shade (Table1). Also, to recording the skin temperature (ST,°C), hair temperature (HT,°C) by digital thermometer, rectal temperature (RT,°C) by clinical thermometer and respiration rate (RR/prm) was counted from movements of flank in one minute.

All measurement was performed 08:00 h at the morning. The calves weighted (BW, kg) every month and calculate the average daily gain (ADG, kg) and relative daily gain (RDG, %). The calves less than year of age weighted 6 times and the calves greater than year of age weighted 8 times.

Table 1. Means (μ) and standard errors (SE) for natural air temperature (AT, °C), relative humidity (RH, %) and Temperature-humidity index (THI) at 08:00 h morning during winter and summer seasons for two farms.

	Farm 1			Farm 2		
Season	AT, °C	RH, %	THI	AT, °C	RH, %	THI
Winter	16.0±1.7	80.6±2.6	60.5	11.7±0.9	50.6±3.3	54.4
Summer	28.8±1.5	75.5±1.7	80.4	18.0±1.6	35.2±2.5	62.0

Farm1 : Farm in the old land (village) Farm2 : Farm in the reclaimed land

The data were analyzed using SAS (2002), according to the following model:

$$Y_{ijklm} = \mu + F_i + A_j + N_{ijk} + S_l + (FA)_{ij} + (AS)_{jl} + (FS)_{il} + (AFS)_{ijl} + E_{ijklm}$$

Where: Y_{ijklm} : the observation m^{th} of the i^{th} farm in the j^{th} age in the k^{th} animal within the j^{th} age within the i^{th} farm in the l^{th} visit season, μ : overall mean, F_i : fixed effect due to the farm (i: 1 farm in the old land, 2 farm in the reclaimed land), A_j : fixed effect due to the age (j: 1 less than year of age, 2 greater than year of age), N_{ijk} : fixed effect due to the k^{th} animal within the j^{th} age within the i^{th} farm, S_l : fixed effect due to the visit season (l: 1 Winter, 2 Summer), $(FA)_{ij}$: the interaction between farm and age, $(AS)_{jl}$: the interaction between age and visit season, $(FS)_{il}$: the interaction between farm and visit season, $(AFS)_{ijl}$: the interaction between age, farm, and visit season and E_{ijklm} : random error assumed N.I.D. (0, $\sigma^2 e$).

Estimate the average (ADG, kg) and relative (RDG, %) daily gain according to the following equations:

$$ADG = (W2 - W1) / (D2 - D1)$$

$$RDG = (ADG / W1) \times 100$$

Where: W1, the first weight, W2, the second weight, D1, at the time of first weight, D2, at the time of second weight.

The following equation was used to determine the temperature humidity index (THI) as indicator of that combined climatic conditions (Castaneda *et. al.,* 2004).

$$THI = (1.8*T + 32) - (0.55 - 0.0055\ RH)\ (1.8*T - 26)$$

Where: T is air temperature (°C), RH is the relative humidity (%).

RESULTS AND DISCUSSION

Physiological response

Table (2) show the unadjusted means and SE of HT, ST, RT and RR at 08:00 h for buffalo calves during two seasons, two ages and under conditions of two farms. While Table (4) show the adjusted means and SE for all traits.

(Table 3) show the analysis of variance for HT, ST, RT and RR. The effect of animal within age within farm, age, farm and season on HT, ST, RT and RR were highly significant ($P \leq 0.001$).

The effect of the interaction between age and farm on HT, ST and RR was highly significant ($P \leq 0.001$) but on RT was significant at $P \leq 0.01$. The effect of the interaction between age and season on HT, ST was significant at $p \leq 0.01$ and on RR was highly significant ($P \leq 0.001$) but on RT was not significant ($P > 0.05$).

The effect of interaction between farm and season on ST and RR was highly significant ($P \leq 0.001$) but not significant ($P > 0.05$) on HT and RT. The effect of the interaction between age, farm and season on HT and ST was highly significant ($P < 0.001$) and RR was significant at $P < 0.05$ but on RT was not significant ($P > 0.05$).

All interaction effects on RR were significant due to RR most sensitive index and reflected more response to the environmental conditions than other physiological responses (Vihan and Sahni, 1981, Ashour, 2004, Omran, 1999, 2008 and Omran *et. al.,* 2011), but the interaction effects on RT were not significant except interaction between age and farm may be due to the THI values in two farms were nearly comfort for animal except in summer of farm 1, the value of THI was beginning stress.

Shafie et. al. (1994) found that, diurnal monthly and seasonal variations in environmental temperature have significant effects on body temperature.

All interaction effects on ST were significant also on HT except interaction between farm and season. This results due to air temperature at morning, this result agreement with Shafie and El-Sheikh Aly (1970), they found clear accordance between HT, ST and AT during seasons and at diurnal times.

Table (4) Show the least square means (LSM) and SE of HT, ST, RT and RR. It is clear that the LSM values of HT, ST, RT and RR showed greater increase at age less than year comparative with age greater than year. This is accordance with changes in proportion (%) surface area (SA) and in hair coat characteristics with advancement of age. Buffalo have a different type of coat in young buffalo the brownish hair 2 to 3 cm long and lies near the skin to provide an almost complete cover. As the animal grows, so that adult hairs 3 to 5 cm long are scattered sparsely and provide no insulation. The SA of the animal is the inter-phase for skin convective, radiant evaporative heat loss, complemented by convective and evaporative heat loss via the respiratory system (Berman, 2003).

The LSM values of HT and ST were higher in farm (1) than farm (2), on the other hand, RT and RR values were lower in farm (1) than farm (2). This results due to values of RH at morning were high in farm (1) than farm (2), this decreased dispersion the heat production from animal by natural ways. Thus increased ST and HT compare with farm (2), animal in farm (2) inside the close house and this effect of dispersion by natural ways. RT and RR were high sensitive to any change low in AT and RH thus higher values of RR and RT in farm (2) than farm (1). The RT and RR were good measures to detect the response of animal to variation in temperature and humidity giving a clear evidence of better capacity of heat tolerance (Shafie *et. al.,* 1994, Ashour *et. al.,* 2004, Omran, 2008 and Omran *et. al.,* 2011). Value of RR increased by 2.5 prm but RT increased by 0.43 °C this due to the RR play an important role in thermoregulatory mechanism amongst all physiological reactions and body temperature comes next (Kundu and Bhatnagar, 1980).

The effect of season showed that, all LSM values for all traits were higher in summer than winter. The physiological mechanisms of the animals are always endeavoring to cope with the diurnal and seasonal fluctuations in the environmental conditions. With higher AT and RH values the HT, ST, RT and RR values were increased. Many authors reported that, values of HT, ST, RT and RR increased in summer comparative in winter (Shafie, 1989, Shafie *et. al.,* 1994, Syah, 1997, Ashor *et. al.,* 2004, Omran, 1999, 2008 and Omran *et. al.,* 2011).

Growth response

Table (5) show the unadjusted means and SE of body weight (BW, Kg), average daily gain (ADG, Kg) and relative daily gain (RDG, %) for buffalo calves at less than year of age and greater than year of age, during winter and summer, under two farms condition. While Table (7) show the adjusted means and SE for all traits.

Table (6) show the analysis of variance for BW, ADG and RDG. The effect of animal within age within farm, age, farm and season on BW, ADG and RDG were

highly significant ($P \leq 0.001$) except the effect of seasons on ADG was significant at $P \leq 0.05$ and the effect of animal within age within farm of RDG was significant at $P \leq 0.01$.

All interaction effects on ADG were not significant, while on BW were highly significant except the interaction between age, farm and season. The effects on RDG were not significant except the interaction between age and farm. The climatic conditions effect of the amount of food and water intake. This is clearly in Table (7) that appears the least square means (LSM) and SE for BW, ADG and RDG.

For age, the live body weight (BW) and ADG values were high for calves greater than year of age compared with calves less than year of age. The live body weight of buffalo increased with advanced the age (Yousef, 1990 and Ashour *et. al.,* 2000). Omran (1999) found that the highest daily gain was between 15-18 month and drop in daily gain between 9-12 months. May be that due to complete of rumen function, sexual hormones and complete skeleton development.

The live body weight (BW) and ADG values were higher in farm (1) than in farm (2). This result may be due to feeding and ambient temperature.

For season, the live body weight (BW) and ADG values were higher in summer than in winter. Omran (1999) reported that the percentage of roughage in the consumed ration was more in summer than in winter. During summer the animals are given a lot of roughage and concentrate, may be that explain this increase in BW. On the other hand, the metabolism of animal increase in winter than in summer because to need energy for worming of body and production but in summer, energy is inset to production (meat or milk).

Animals increase feed intake (FI) under cold condition and decreased it under hot conditions, the values of THI were 80.4 and 62 during summer in farm (1) and farm(2), respectively. The environmental condition, housing and feeding caused to reflect the results comparative with many authors. They found that, the BW and ADG increased in winter than in summer because the high temperature decreased feed intake and metabolism to decreased heat production to lower the stress (Baile and Frobes, 1974, Baccari et. al., 1990, Nangia and Gary, 1992, Omran, 1999 and 2008).

CONCLUSION

Farm 1 (old land) was better for growth rate and physiological responses than farm 2 (reclaimed land). The buffalo calves were successful live in the reclaimed land with harsh conditions. The higher values of boy weight (BW) and average body gain (ADG) were recorded at summer than winter due to feeding system and housing,

may be, the roof from maize stoke above unit of wood and house made from clay leading to decrease the effect of air temperature and relative humidity this clearly from values of THI in farm (2) inside the house. Economically, prefer fattening buffalo calves over one year. Accordingly, buffalo breeding in the reclaimed land give good production.

Table 2. Unadjusted means (μ) and standard errors (SE) for hair temperature (HT,°C), skin temperature (ST, °C), rectal temperature (RT, °C) and respiration rate (RR/prm) at different ages and seasons in two farms on buffalo calves.

Trait	Winter		Summer	
	Farm 1	Farm 2	Farm 1	Farm 2
Less than year of age				
HT	33.3±0.05	28.1±0.5	34.6±0.06	31.1±0.11
ST	34.9±0.04	31.1±0.52	35.6±0.03	33.1±0.22
RT	37.6±0.02	38.0±0.03	37.9±0.03	38.2±0.04
RR	21.8±0.12	22.5±0.90	21.4±0.16	22.7±0.56
Greater than year of age				
HT	30.7±0.13	32.9±0.10	33.2±0.07	33.6±0.08
ST	34.7±0.05	34.6±0.08	35.6±0.03	35.3±0.05
RT	37.3±0.03	37.7±0.12	37.5±0.02	38.1±0.04
RR	18.5±0.17	20.0±0.15	21.6±0.12	25.3±0.25

Farm1 : Farm in the old land (village) Farm2 : Farm in the reclaimed land

Table 3. Analysis of variance for hair temperature (HT,°C), skin temperature (ST, °C), rectal temperature (RT, °C) and respiration rate (RR/prm).

Source of Variation	df	M.S			
		HT	ST	RT	RR
Farm – Age - Animal	82	11.47 ***	12.83 ***	0.63 ***	108.78 ***
Age (A)	1	154.80 ***	435.16 ***	18.79 ***	136.01 ***
Farm (F)	1	532.76 ***	670.61 ***	43.39 ***	742.21 ***
Season (S)	1	783.41 ***	276.10 ***	19.61 ***	971.03 ***
Interaction :					
A*F	1	1856.39 ***	506.17 ***	0.74 **	146.44 ***
A*S	1	16.87 **	13.77 **	0.08 ns	1029.45 ***
F*S	1	0.24 ns	14.93 ***	0.22 ns	122.70 ***
A*F*S	1	169.59 ***	27.57 ***	0.15 ns	34.18 *
Error	1101	1.97	1.49	0.13	7.27

* : P≤0.05 ** : P≤0.01 *** : P≤0.001 ns : Not significant (P>0.05).

Table 4. Least square means (LSM) and standard errors (SE) for hair temperature (HT,°C), skin temperature (ST, °C), rectal temperature (RT, °C) and respiration rate (RR/prm).

Main Effect	LSM±SE			
	HT	ST	RT	RR
Age :				
Less than year of age	32.59±0.05	35.05±0.05	37.92±0.02	22.11±0.15
Greater than year of age	31.79±0.08	33.68±0.07	37.64±0.01	21.34±0.10
Farms :				
Farm 1	32.96±0.07	35.22±0.06	37.56±0.02	20.83±0.13
Farm2	31.42±0.06	33.51±0.06	37.99±0.02	22.62±0.12
Season :				
Winter	31.27±0.07	33.81±0.06	37.63±0.02	20.70±0.13
Summer	33.11±0.06	34.91±0.05	37.92±0.02	22.75±0.12

Farm1 : Farm in the old land (village) Farm2 : Farm in the reclaimed land

Table 5. Unadjusted means (μ) and standard errors (SE) for body weight (BW, kg), average daily gain (ADG, kg) and relative daily gain (RDG, %) at different ages and seasons in two farms.

Trait	Winter		Summer	
	Farm 1	Farm 2	Farm 1	Farm 2
Less than year of age				
BW, kg	203.0±3.06	110.0±3.85	261.0±3.0	159.0±4.81
ADG, kg/day	0.63±0.02	0.47±0.03	0.65±0.01	0.55±0.03
RDG, %	0.33±0.01	0.48±0.03	0.27±0.01	0.40±0.02
Greater than year of age				
BW, kg	296.0±3.16	209.0±0.95	367.0±3.89	340.0±6.45
ADG, kg/day	0.81±0.01	0.65±0.03	0.83±0.02	0.72±0.05
RDG, %	0.32±0.01	0.26±0.01	0.25±0.01	0.23±0.01

Farm1 : Farm in the old land (village) Farm2 : Farm in the reclaimed land

Table 6. Analysis of variance for body weight (BW, kg), average daily gain (ADG, kg) and relative daily gain (RDG, %).

Source of variation	df	M.S		
		BW	ADG	RDG
Farm - Age - Animal	82	17414.41 ***	0.11 ***	0.01 **
Age (A)	1	2027873.46 ***	3.15 ***	1.21 ***
Farm (F)	1	429091.54 ***	1.86 ***	0.25 ***
Season (S)	1	653004.91 ***	0.23 *	0.39 ***
Interaction :				
A*F	1	198547.71 ***	0.01 ns	0.78 ***
A*S	1	40874.92 ***	0.01 ns	0.01 ns
F*S	1	5957.60 **	0.07 ns	0.001 ns
A*F*S	1	506.35 ns	0.001 ns	0.02 ns
Error	621	827.17	0.05	0.01

* : P≤0.05 ** : P≤0.01 *** : P≤0.001 ns : Not significant (P>0.05).

Table 7. Least square means (LSM) and standard errors (SE) for body weight (BW, kg),average daily gain (ADG, kg) and relative daily gain (RDG, %).

Main Effect	LSM±SE		
	BW (kg)	ADG (kg/day)	RDG (%)
Age :			
Less than year of age	183±2.05	0.58±0.02	0.37±0.01
Greater than year of age	309±1.50	0.75±0.01	0.26±0.01
Farms :			
Farm 1	275±1.94	0.73±0.02	0.29±0.01
Farm2	217±1.65	0.60±0.01	0.34±0.01
Season :			
Winter	210±1.88	0.64±0.02	0.35±0.01
Summer	282±1.72	0.69±0.01	0.29±0.01

Farm1 : Farm in the old land (village) Farm2 : Farm in the reclaimed land

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كفائة النمو والأستجابة الفسيولوجية لعجول الجاموس تحت الظروف البيئية المختلفة

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إجريت هذه الدراسة علي 86 عجل جاموس في مزرعتين للتسمين، المزرعة الأولي في الأرض القديمة (القرية) والمزرعة الثانية في أرض أستصلاح تسمي أرض المروج في قرية أوسُكر، مدينة الصف، محافظة الجيزة. 34 عجل جاموس في المزرعة الأولي، 19 عجل عمرهم أكبر من سنة (متوسط الوزن يتراوح ما بين 230–270 كجم) ، 15 عجل عمرهم أقل من سنة (متوسط الوزن يتراوح ما بين 168 – 205 كجم) والمزرعة الثانية، 52 عجل جاموس، 34 عجل أكبر من سنة (متوسط الوزن يتراوح ما بين 191 – 234 كجم)، 18 عجل أقل من سنة (متوسط الوزن يتراوح مابين 61 – 156 كجم).

الهدف الرئيسي من هذه الدراسة هو مقارنة كفائة النمو والأستجابة الفسيولوجية لعجول الجاموس المرباه في مزرعتين أحداهما موجودة بألارض القديمة (القرية) والآخري بأراض مستصلحة.

وكان من أهم النتائج، أن المزرعة المتواجدة في القرية كانت أفضل في معدل النمو وكذلك الأستجابة الفسيولوجية من المزرعة المتواجدة في أراضي الإستصلاح. نجاح عجول الجاموس في التعايش في أراضي الأستصلاح بالرغم من ملوحة مياه الشرب. التسمين الأقتصادي لعجول الجاموس عندما يكون عمرها أكبر من سنه. وبناء عليه نوصي بتربية الجاموس في أراضي الأستصلاح حيث يعطي إنتاج جيد.