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EFFECT OF PHOTOPERIOD LENGTH ON GROWTH AND SOME PHYSIOLOGICAL ASPECTS OF BUFFALO HEIFERS BY

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ABSTRACT

Fourteen growing buffalo heifers, reared(111.0±2.1) Kg live weight, aged (4.5 ±0.8) monthly, were used to study the effect of photoperiod length on growth and some physiological aspects. Photoperiod systems were 16h of light and 8h of dark for group1 and group2 normal day. Exposure to photoperiod during October to end of March.(darkling season autumn and winter). Growing heifers which exposed to long photoperiod were increased similarly weight gain by 8.8%and feed intake by 4.1%and 4.2% for growth stage 1 and 2 but stage 3 and 4 were not effect without affect in feed efficiency. Heifers exposed to a long photoperiod had greater circulating concentrations of total protein, Albumien, Globulin, T3 and T4 in stage 1, 2 and 3 respectively. Concentrations of previous blood parameters did not differ ($P>0.05$) between systems in stage 4. Progesterone concentration were differences ($P<0.05$) observed between systems stage 3 and sharp differences were recorded in stage 4.These results support the hypothesis that a long daily photoperiod increases feed consumed, daily gain and circulating concentrations of T3, T4 and progesterone in buffalo heifers . Also, reveal a possible endocrine mechanism for the galactoperiod. Long photoperiod caused a major improvement of age and weight of puberty.

Key word: photoperiod, feed intake, blood promoters, reproductive performance

INTRODUCITON

Photoperiod will affect growth and development of ruminants. In buffaloes, long day photoperiod can increase body growth rate, feed intake and improve feed efficiency of buffalo heifers. Roche and Boland (1980)and Sorenson (1983) did not observe any significant effect of photoperiod in very young calves. Furthermore, Zinn *et al.*, (1988) and Reksen *et al.* (1998) reported no significant effects on weight gain and feed intake of prepubertal heifers exposed to 8 h or 16 h of light per day as opposite to post pubertal heifers . Photoperiods are associated with increased circulating protein content, T3, T4 and progesterone in growing heifers . Treatment with exogenous metabolic hormone however, does affect on gonadotrophic hormone in heifers .Thus, the endocrine mechanism that mediates the increase in sex hormones of heifers that are exposed to long photoperiods has remained elusive. Recent studies describing the response

of heifers to photoperiod and specifically the stimulatory effect of long photoperiods on feed intake and circulating concentrations of T3, T4 and progesterone led us to hypothesis that long photoperiods stimulate T3 and T4 secretion on growing buffalo heifers and this stimulation provides an endocrine signal for increased progesterone secretion. This hypothesis was prompted by several observations. First elevations in circulating T3 and T4 are associated with increased growth in growing heifers second, long photoperiods stimulate progesterone in heifers, and these increases can independent of other hormones and metabolism of food . Incidence of anestrous in buffalo heifers was greater in months with short photoperiods. Photoperiod markedly affects serum concentration of sex hormone in many species including calves and exogenous hormone suppresses mammary growth in prepubertal heifers (New Bolod *et al.*, 1991). These variables are commonly used is herd improvement programs because they related to herd economics. As for as we have been able to determine, no other epidemiological studies are available on relationships between light exposure and reproduction in buffalo.

MATERIALS AND METHODS

This study was carried out Mehallet Moussa Experimental Farm, belonging to Animal Production Research Institute (A P R I), Ministry of Agriculture, Egypt, during October 2001 until December 2002, aiming at studying the relationship between photoperiod length and some parameters such as ovarian and estrous cyclicty, daily gain, T3, T4, total protein, albumin.

Fourteen female heifers after weaning weighted (111.0± 2.1) and aged (4.5±0.8 months) were randomly assigned to two similar groups (7 animals each).

During winter season (October- March) animals in group (1) were under artificial lighting (after the sunset) to reach the level of summer day light (16 hours light, 8h. dark). Ambient temperature and humidity was determined at morning 9 a. m. and at night 10 p.m.(before to switch off the light over animal body) Group 2 was in natural conditions during same season. Growth were divided into four stages.

All experimental heifers were fed one ration contained similar ingredients with the same proportions of concentrate feed mixture (C F M), berseem and rice straw (R S) in the green season. The CFM consisted of 30 % undecorticated cottonseed meal, 35% wheat bran, 16% yellow corn, 10% rice bran, 5%vines, 3% limestone and 1% common salt. In summer season, animals fed concentrate feed mixture, hay and rice straw. The heifers were fed according to animal production research institute (A P R I) allowances for growing heifers(1997) and Abou-Raya (1967). Feeding allowances were offered twice daily.

Daily rations of the two groups were adjusted every month according to the changes of body weight. Animals were allowed to drink water two times a day.

Table (1): Chemical composition of the feed stuffs and its nutritive values as DM.

Item	Chemical composition			
	CFM	Fresh berseem	Hay	Rice straw
DM%	89.90	13.00	90.00	90.20
..... On DM basis %				
OM	88.75	87.50	86.70	84.20
CP	16.30	16.62	13.60	3.91
CF	3.30	13.20	18.10	21.14
EE	13.50	4.64	14.20	28.03
NFE	55.65	53.04	40.80	31.12
ASH	11.25	12.50	13.30	15.80
Nutritive values*				
TDN%	67.00	57.55	42.35	36.00
DCP%	11.80	12.00	10.00	00.00

* calculated according to Abou-Raya (1976)

Efficiency of feed utilization was calculated as of 1 kg growing by kg DM, TDN and DCP consumed.

Blood samples were withdrawn individually biweekly throughout the experimental period. Blood were collected from jugular vein at the start of night and centrifuged at 4.000 r.p.m. for 20 minutes and the serum was stored frozen at –20c° until the time of hormonal assay the serum total protein and albumin were determined according to Doumas *et al.*, (1971) and globulin was estimated by difference. Triiodothyronine (T3) by Larsen (1972) and Tetraiodo thyroxin (T4) by Chopra (1972)and progesterone were determined by radioammunassay using solid-phase tube. Serum globulin (G) albumin (A), A/G ratio and T4/T3 ratio were calculated. The growing heifers treated until to puberty.

The economical efficiency for daily gain produced expressed as the ratio between the price of live body weight produced and the cost of feeds consumed was estimated on the basis of the following prices per 1 kg live body weight 10 LE, concentrate feed mixture 700 LE/ ton, berseem 48 LE / ton, and rice straw 27 LE /ton, reproductive performance of experimental heifers included estrus cycle and progesterone level. The data obtained were subjected to statistical analysis according to S.A.S.(1990).

$Y_{ijk} = \mu + T_i + Sj + (T_S)_{ij} + e_{ijk}$

Where s:

Y_{ij}: Is the observation taken on the i^{th} animal,

μ:Overall mean,

T_i:Effect of photoperiod length and

Sj: Effect of stage of growth

$(T_S)_{ij}$: Interaction between photoperiod length and stage of growth

e_{ijk}: Random error

Differences among means were tested for significant by using multiple range test of Duncan (1955).

RESULTS AND DISSCUTION

Feed intake

These results clearly show that initial photoperiod exposure might affect the animals responsiveness to a subsequent photoperiod exposure. Indeed, initial exposure to photoperiod during stage 1 did slight increase D M, CP, TDN and DCP intake.

Table (2): Daily feed intake as DM, CP, TDN and DCP (kg) of the experimental animal

Growth stages	Experimental groups			
	Group 1			
	D M	C P	T D N	D C P
Stage 1	3.22	0.43	1.94	0.220
Stage 2	6.30	0.90	3.87	0.621
Stage 3	12.40	1.41	6.84	0.939
Stage 4	13.20	1.44	7.1	0.941
	Group 2			
Stage 1	3.01	0.420	1.83	0.209
Stage 2	6.5	0.906	3.93	0.619
Stage 3	12.5	1.45	7.00	0.974
Stage 4	12.8	1.45	7.00	0.962

D.M:dry matter, C.P:crude protein, T.D.N: total digestible nutrition, D.C.P: digestible protein.

However, in the third stage there was no effect of feed intake . But fourth stage when the animals in the second photoperiod exposure there was slight increase of feed intake for CP and DCP Table (2). The present data are in agreement with Peters *et al.*, (1978, 1980) and Petiteclerc *et al.*, (1983). On the contrary, present data not agreement with Kay *et al.*, (1972), Petitclerc and Zinn (1990) . Guertin *et al.*, (1995) they studied that effects of photoperiod and feeding whole maize, whole barley, or rolled barley on growth performance and diet digestibility in veal calves.They found that there was no significant effect ($p<0.05$) on overall feed intake gain ratio. On the other hand, growth rate, daily DM intake were not affected by subsuequent photoperiod treatments.

Generally: the pervious exposure of long day light affected the magnitude of photoperiod induced in animal feed intake. Zinn *et al.*, (1988) clearly show that previous photoperiod expose will affect animals response to feed intake and daily gain

Growth performance:

The present data of initial body weight, total gain relative gain and daily gain of experimental buffalo heifers are illustrated in Table (3). These results

indicated that heifers were exposed to long photoperiod during stages of growth increase weight gain by 4.1 and 4.2 in stage 1 and 2 respectively.

Table (3): Effect of long photoperiod on growth performance for buffalo heifers.

Growth Stages	Age (months)	Experimental groups			
		Group 1			
		Initial weight (Kg)	Total gain (Kg)	Relative gain %	Daily gain (Kg)
Stage 1	4 –5	111.9+3.6	41.70^{a} ± 0.3	34.00 ± 0.3	0.625^{a}
Stage 2	6 – 8	153.60+6.4	68.00^{a} ± 0.2	45.33^{a} ± 0.1	0.756^{a}
Stage 3	9 – 10	221.70 +11.2	71.60^{a} ± 0.3	32.84^{a} ± 0.2	0.800^{a}
Stage 4	11 – 1st estrus	298.6+13.26	69.30^{a} ± 0.2	23.93^{a} ± 0.1	0.578^{a}
		Group 2			
Stage 1	4 –5	110.14+2.5	40.60^{b} ± 0.2	36.90 ± 0.4	0.451^{b}
Stage 2	6 – 8	150.7+2.5	50.40^{b} ± 0.1	33.44^{b} ± 0.5	0.650^{b}
Stage 3	9 – 10	201.1+11.2	76.76 ± 0.1	38.17^{b} ± 0.2	0.582^{b}
Stage 4	11 – 1st estrus	277.8+12.7	61.44^{b} ± 0.1	22.11^{b} ± 0.3	0.512^{b}

a and b: means with different superscripts in the same row are different significantly ($p<0.05$).

Present results agreement with Peters *et al.*, (1979, 1980) Petitclerc *et al.*, (1983). And Guertin *et al.*, (1995) they reported that initial exposure to photoperiod during 1 to 6 weeks did increase body weight gain by 6.6%. Also, the same results reported by Zinn *et al.*, (1988) also noted the same results. They showed animal was exposure sufficient in duration to prevent recognition by the animals of a subsequent photoperiod signal. Reported in a note, the previous exposure affected the magnitude of photoperiod- induced changes in animal growth..Dahl and Petitclerc (2003) they reported that in growing heifers, photoperiod management can be used to improve heifers growth and maximize accretion of lean tissue .

Generally, heifers were exposed to long light days after 4-5 months of age, there was effect on live body weight gain and feed intake.

Blood Parameters:

Data presented in Table (4) indicated that the highest concentration of blood proteins and thyroid hormones were detected when photoperiod length was 16h. (G1), while the lowest values were observed with normal day light (G2).

There were no significant differences ($p<0.05$) among G1 and G2 was observed in blood constitute, Total protein, Albumin, Globulin and its ratio and T3, T4 and its ratio in growth stage 1. But significant ($p<0.05$) of stages 2, 3 and of growth among tested groups.

The present results agreement with Enaam and Barkawi (1990) they studying T3/T4 ratio relation to growth rate of Egyptian buffaloes and they found monthly T3 and T4 showed a grater increase in their concentration and showed fluctuation pattern within each season. The ratio of T3/T4 in the present results was higher than they reported by Enaan and Barkawi (1990).

Table (4): Effect of long photoperiod on some blood parameters.

Item	Experimental group 1	Experimental group 2	Overall mean
	Stage 1		
Total protein	5.25±0.4	4.56±0.3	4.91±0.4
Albumein	2.81±0.2	2.98±0.3	2.9 ±0.3
Globulin	2.45±0.5	1.57±0.4	2.01±0.5
A/ G ratio	1.15	1.9	1.53
T3	108.4±14.5	104.6±13.4	106.5±14.0
T4	3.35 ±0.5	3.45±0.4	3.4±0.5
T3/T4 ratio	32.36	30.32	31.34
	Stage 2		
Total protein	5.54^{b} ±0.4	5.66^{a} ±0.4	5.6±0.38
Albumein	3.87±0.3	3.90±0.5	3.89±0.4
Globulin	1.67 b ±0.4	1.76±0.4	1.72±0.4
A/ G ratio	2.3	2.2	2.3
T3	160^{b} ±12.7	192^{a} ±11.88	176±12.3
T4	3.87^{b} ±0.3	5.8^{a} ±0.4	4.84±0.37
T3/T4 ratio	41.34	33.10	37.2
	Stage 3		
Total protein	5.58^{b} ±0.4	6.15^{a} ±0.37	5.87±0.3
Albumein	3.39±0.3	3.16±0.3	3.3±0.03
Globulin	2.19^{b} ±0.5	2.99^{a} ±0.7	2.6±0.6
A/ G ratio	1.55	1.1	1.33
T3	142.72±10.3	140 ±9.8	141.36±10.1
T4	3.73^{b} ±0.3	4.05^{a} ±0.6	3.89±0.5
T3/T4 ratio	38.26	34.57	36.42
	Stage 4		
Total protein	6.49^{a} ±0.4	5.95^{b} ±0.3	6.22±0.3
Albumein	3.39^{a} ±0.4	3.51^{b} ±0.3	3.45±0.35
Globulin	3.1^{a} ±0.6	2.44^{b} ±0.37	2.77±0.5
A/ G ratio	1.10	1.40	1.25
T3	170.41^{b} ±19.5	178.36^{a} ±19.42	174.39±19.46
T4	4.8^{a} ±0.3	4.3^{b} ±0.5	4.55±0.4
T3/T4 ratio	35.50	43.57	39.53

a and b: means with different superscripts in the same row are different significantly ($p<0.05$).

In generally long photoperiod length cause improvement blood protein and thyroid hormones and its ratios

Effect of photoperiod length on age at puberty:

The progesterone was analyzed to determine if exposure of prepubertal supplemental lighting hastens the onset of puberty.Prgesterone was monitored biweekly in as an index of puberty (greater than 1 ng/ml).

Table (5) shows that age at first ovulation and first estrus were less for group 1 (16 hrs light) than group 2 (8 hrs light). Average ages at first ovulation were 12.6 ± 0.1 (group 1) and 13.3 ± 0.2 (group 2). These results may be due to that light hastens the rate of ovarian growth in heifers. These results agree with that reported by Hansen *et al.*, (1983), Peters *et al.*, (1981) and Dahl and Petitclerc (2003). Heifers in group 1 which had faster gain and they exposure to artificial light in autumn and winter, they reached earlier to age and weight of first estrus than heifer in group 2 Table (5).

The effects of a long photoperiod on progesterone level in the heifers must be considered in context of the biological outcome, that is, increased weight gain. Petiticlerc *et al.*, (1988) have suggested that the light effects of growth in ruminants are mediated by the consentient increase in circulating concentrations of hormones. Nany (1999) reported that the seasonal condition as a whole (low ambient temperature and long day light length with the availability of green fodders) have an enhancement effect on ovarian activity of Egyptian buffaloes.

Table (5): Effect of photoperiod length on age at puberty.

Item	Experimental groups		
	Experimental group 1	Experimental group 2	Over all mean
Age of puberty (at heat) (month) (first progesterone > 1ng/ml)	10.50^{a} ±0.20 month	11.70^{b} ± 0.40 month	11.10 ± 0.30
Age at first ovulation and first estrus	12.60^{a} ± 0.10 month	13.30^{b} ± 0.20 month	12.95 ± 0.20
Weight at puberty (kg)	218.00^{a} ± 11.20	201.10^{b} ± 10.20	209.50 ± 10.70
Weight at first ovulation (kg)	298.60^{a} ± 13.30	277.80^{b} ± 12.70	288.20 ± 13.00

a and b: means with different superscripts in the same row were different significantly ($p<0.05$)

Climatic thermal condition:

The present results of ambient air temperature and humidity as recorded diurnally by photoperiod length during autumn and winter season (short day light) are illustrated in Table (6). Animals were exposed to the lowest temperature and humidity, particularly in the morning in all stages of the experiment for group 2. It is clear from the Table (6) that the diurnal differences in ambient temperature were significant differ ($P<0.05$) in the evening, but in the morning not differ significantly among testes groups.

Table (6): Effect of photoperiod length on ambiant temperature and humidity

Growth stags	Time	Experimental groups			
		Experimental group 1		Experimental group 2	
		Temperature	Humidity	Temperature	Humidity
1	---	----	-----	------	------
2	Morning	20.96±1.29	65.15±1.37	19.68±1.14	67.15±1.30
	Evening	22.87[a]±1.43	68.5±0.90	20.67[b] ±1.27	67.45±1.29
3	Morning	23.65±0.47	60.69±1.25	22.80±0.36	59.62±1.18
	Evening	25.28[a] ±0.88	65.15±1.19	22.25[b] ±0.81	64.92±1.16
4	Morning	28.61±0.70	62.63±0.97	25.10±0.60	62.02±0.98
	Evening	24.23[a] ±0.80	66.61±0.80	21.17[b] ±0.43	66.02±0.87

[a] and [b] means with different superscripts in the same row were different significantly ($p<0.05$).

Feed conversion and economic efficiency:

As shown in Table (7) the buffalo heifers which subjected to elongated photoperiod (G1) achieved higher feed conversion than those in (G2) during the 1st and 2nd stage of growth. However advancement of growth period no differences were found between the studies groups.

The feed efficiency as DM, CP, TDN and DCP and economic efficiency of the experimental groups at the stages were illustrated in Table (7).

Table (7): Effect of long photoperiod on feed conversion and economic efficiency for buffalo heifers.

Growth stages	Experimental group 1				
	D M	C P	T D N	D C.P	Economic efficiency
1	20[a]+0.10	1.46[a]+0.20	0.33[a]+0.10	2.89+0.20	0.33[a]+0.30
2	0.12[a]+0.20	0.83[a]+0.10	0..20[a]+0.20	1.22+0.30	0.15[a]+0.20
3	0.06+0.10	0.57+0.20	0.12+0.10	0.85+0.40	0.15+0.20
4	0.04+0.30	0.40+0.10	0.08+0.40	0.61+0.20	0.12+0.30
	Experimental group 2				
1	0.15[b]+0.20	1.07[b]+0.10	0.25[b]+0.20	1.56[b]+0.30	0.23[b]+0.40
2	0.09[b]+0.10	0.62[b]+0.30	0.14[b]+0.20	0.91[b]+0.30	0.11[b]+0.30
3	0.07+0.30	0.58+0.40	0.12+0.10	0.87+0.60	0.16+0.30
4	0.04+0.10	0.35+0.60	0.70+0.20	0.53+0.40	0.13+0.40

[a] and [b] means with different superscripts in the same row were different significantly ($p<0.05$).

The tabulated data further indicate that total feed intake as DM, CP, TDN and DCP also increased progressively as hours of days increased (day-light length) . However, the differences in this concept were not significant in stage 3 and 4 respectively . In respecting with economic efficiency of daily gain and feed

efficiency than group 2 at stage 1 and 2. However animal group 2 tended to more efficient than animals in group 1 at stage 3 and 4. There were no significant affect between experimental groups in stage 3 and 4. The results obtained during the first and second stages of growth agree with Afify *et al.*, (2004) and Guertin *et al.*, (1995) with calves of similar weight .

Generally photoperiod will affect growth performance and development of feed consumed . In growing buffalo heifers, long day photoperiod can increase body growth and feed intake, and improve feed efficiency . The present results cleared that no significant effects on weight gain and feed consumed of prepubertal and pubertal buffalo heifers exposed to long day light in autumn and winter season.

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تأثير طول فترة الاضاءة على النمو وبعض المظاهر الفسيولوجية فى عجلات الجاموس

هدى زكى حسن ، أحمد عبدالله عفيفى ، ناتى سيد ابراهيم ، سهير محمود زيدان
معهد بحوث الانتاج الحيوانى-مركز البحوث الزراعية -وزارة الزراعة – مصر

أجرى هذا البحث بمحطة بحوث الانتاج الحيوانى بمحلة موسى التابعة لمعهد بحوث الانتاج الحيوانى-مركز البحوث الزراعية

أستخدم فى هذا البحث أربعة عشر عجلة جاموسى نامية متوسط وزنهـــــا (١١١,٥ ±٢,١كجم) متوسط عمرها(٤,٥ ±٠,٨ شهر) لدراسة تأثير طول فترة الاضاءة على نموها . وزعت هذه العجلات عشوائيا على مجموعتين (سبعة عجلات بكل مجموعة) . ثم قسمت مراحل النمو إلى أربع مراحل.

غذيت العجلات كلها على عليقة واحدة متشابهة فى المكونات (علف مركز – برسيم فى الموسم الاخضر – دريس برسيم وقش الأرز) وزعت الحيوانات عشوائيا الى مجموعتين حسب فترات الاضاءة كالأتي:

المجموعة الأولى: تعرضت الى الاضاءة ١٦ ساعة يوميا من شهر اكتوبر الى نهاية مارس.

المجموعة الثانية: لم تتعرض لاى زيادة فىالاضاءة اى طول النهار العادى خلال تلك الفترة. وقد اوضحت مايلى:-

١. ادت زيادة فترة الاضاءة الى تحسن معنوى فى معدل النمو اليومى فى فترة النمو الاولى والثانية بينما كانت غير معنويه في الفترة الثالثة والرابعه .
٢. ادت زيادة تعرض العجلات لفترات الاضاءة الى تحسن معنوى فى بروتين الدم وكذلك هرمون T3, T4فى فترة النمو الاولى والثانية والثالثة على الترتيب. بينما كانت الزيادة فى هرمون البرجسترون غير معنوية فى فترة النمو الأولى والثانية وكانت معنويه فى الفترة الثالثة والرابعة وظلت عجلات المجموعة التى تعرضت للإضاءة الى البلوغ اسرع من عجلات المجموعة الثانية.
٣. تحسنت الكفاءة الغذائية للعجلات التى تعرضت الى ساعات الإضاءة عن العجلات الأخرى.
٤. حدث تحسين فى الكفاءة الغذائية والإقتصادية وقلت تكاليف التغذية لانتاج كيلوجرم نمو بزيادة فترات الاضاءة – مقارنة بالمجموعة التى لم تتعرض للإضاءة .
٥. نستنتج من هذه الدراسة أن زيادة فترات الإضاءة خلال النهار القصير أدى الى تحسن فى المأكول اليومى وكذلك معدل النمو اليومى ووصول العجلات الى البلوغ مبكرا عن العجلات التى لم تتعرض للإضاءة.