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RELATIONSHIP BETWEEN PLASMA IGF I, BODY WEIGHT AND AGE AT PUBERTY IN LOW BODY WEIGHT MURRAH CALVES AND EFFECT OF SUPPLEMENTATION OF FERMENTED YEAST CULTURE IN THE IMPROVEMENT OF PRODUCTIVE PARAMETERS

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ABSTRACT
Aim of the present study was to find the relationship between plasma IGF I, Haptoglobin with body weight and age at puberty in Murrah buffaloes. To evaluate the effect of supplementation of fermented yeast culture ((*Saccharomyces cerevisiae*) to low body weight calves, for improvement in body weight of low body weight calves and in advancing the age of puberty through plasma parameters. In the present study twenty female Murrah calves with low body weight (100 ±10 Kg), at nine months of age were selected. The concentration of plasma IGF I and Haptoglobin were estimated. Weekly blood samples were collected and monthly body weights were recorded. The female calves were divided equally in to two groups. The experiment was conducted till they attained fourteen months of age. In one group calves were supplemented with commercial fermented yeast culture (*Saccharomyces cerevisiae*) @ 12g/ animal/ day along with the concentrate. They were provided with wheat straw based diet and concentrate in the ratio 1:1 @ 3kg/100kg B W. Similarly fermented yeast culture was supplemented @24g/animal/day from fourteenth month till they attained puberty. Calves or heifers which did not receive supplementation of yeast culture served as control. The age of the heifers was recorded on attaining puberty. Blood plasma was separated. Plasma IGF I and Haptoglobin were measured by Enzyme immuno assay (EIA). Dry matter intake and feed conversion efficiency were also estimated, based on feed intake and feed refusal per day. On supplementation of yeast culture for four successive months the concentration of plasma IGF I, was significantly more ($P<0.01$) in the supplemented group where as concentration of plasma Haptoglobin was not significantly different between the groups. The average daily gain in the body weight of animals (≥700g /day) was observed in supplemented group whereas in non supplemented group the average daily gain was observed to be @≤700g/day. The estimated DMI /Head/day or DMI/Head/Day/100kgBW was not significantly different between the groups. The feed conversion efficiency was observed to be significantly greater ($P<0.05$) for the supplemented group. After fourteen months of age the average daily gain in the body weight of animals was ≥400g/day whereas in the non supplemented group it was ≤500g/day. The plasma IGF I concentration was also significantly more in the supplemented group ($P<0.05$) throughout the course of the study. Six out of ten Murrah heifers attained puberty at the age of 22 ± 2 months and four attained puberty at the age of 24 ± 2 months. Whereas conception rate to first service was 50% and rest to the second service. In the non supplemented group the heifers attained puberty at the age of 30±2 months. Conception rate to first, second and third service was 10% 30% and 60% respectively.

KEY WORDS: Plasma IGF I, Haptoglobin, anestrous, repeat breeding, body weight, calves, buffalo

INTRODUCTION

Buffalo comprises 20.2% of the total livestock population in the country. There are 8 breeds of buffaloes and Murrah is one of the them. Under optimum conditions, taurine cattle and their crosses attain puberty earlier than zebu cattle, river buffalo and their crosses earlier than swamp buffalo (Basheer, 2006). IGF I is an important growth promoting and metabolic hormone and is expressed in almost all the tissues of the body (Sjogren *et al*., 2002). A positive relationship between peripheral IGF I and progesterone concentrations have been reported by Langendijk *et al*. (2008). During pubertal maturation spurt in plasma IGF I concentration was related with increase in concentration of plasma steroids (Kolesarova *et al*., 2010). Yeast supplementation has been reported to be beneficial in improving live weight gain in calves and lamb. The increase in feed utilization and rumen fermentation enhance milk production and animal performance. Saccharomyces cerevisiae may provide growth factors, vitamins there by stimulates ruminal population of beneficial bacteria (Chaucheyras *et al*., 1996). The objectives of this study are to determine the characteristics of IGF I and Haptoglobin in growing low body weight female Murrah calves and to study the effect of supplementation of fermented yeast culture in the improvement of body weight gain and advancement of puberty in female Murrah heifers.

MATERIALS & METHODS

The present study was conducted at NDRI farm between October 2012 to March 2014. Blood samples were collected at weekly intervals from twenty number of Murrah calves when they were ten months old and continued till they attained fourteen months of age for

studies on growth performance. On the same group of animal's studies on advancement of puberty resumed from seventeen months till they attained puberty. The Mean ± SE values for each parameter were computed for 30 d. The body weight (BW) of calves was low. Average body weight was 110 Kg. Blood samples were collected daily at 8.00 am before giving feed to animals. Feed was offered at 8.30 am in the morning daily. The samples were centrifuged at 3000 rpm for 20 minutes; plasma was separated and stored at -20^{o}C, till further assay of the hormones. The diets were formulated based on recommendations of the NRC (NRC, 2001). Wheat straw and concentrate were offered in the ratio 1:1 @ 3 kg/100 kg BW. Greens were offered @ 2.5 kg/calf/day till thirteen months of age. From fourteen months till puberty, heifers were provided with wheat straw and concentrate as stated above and greens were offered @ 4-5 kg/ heifer/day until they attained puberty. The selected LBW calves were divided into two groups consisting of ten number of Murrah calves in each group. One group served as control, which was without supplementation of fermented yeast culture and experimental group was supplemented with fermented yeast culture (FYC) @ 12g/animal/day. From seventeen months of age they were offered FYC @ 24g/animal/day. In terms of CFU, 3.5 x 10 ^{7} CFU/g of yeast product was fed to the heifers. Plasma concentration of IGF I, Haptoglobin and Progesterone were estimated by Enzyme Immuno Assay as per instructions in protocol provided with the kit. The bovine IGF I asssay kit was purchased from CUSABIO BIOTECH Co.LTD., (USA), Haptoglobin assay kit was purchased from Immunology consultants laboratory INC. (USA), bovine Progesterone (P_4) Elisa kit was purchased from Endocrine Technologies INC. (USA). Daily Feed intake and feed refuse were also estimated. Based on this DMI was calculated. Feed conversion efficiency or ratio was also calculated for both the groups. For examination of uterine tone, for confirmation of estrus, rectal palpation was performed. The experiment on advancement of puberty was initiated on the same group of animals when they were of 17 months (510d) of age and the two respective groups remained the same. It was confirmed that they had not attained puberty or exhibited heat, on the basis of concentration of plasma progesterone, whose concentration was constantly below 0.6 ng /ml in any of the consecutive blood samples till 540d (18months). For confirmation of pregnancy, post artificial insemination (AI), pregnancy diagnosis (PD) was performed by rectal palpation post 60 days. On detection of heat, heifers were subjected to artificial insemination. After insemination, till 45-60 d, when the heifers did not exhibit heat, they were subjected to PD, when observed to be positive, blood samples were not collected further from these heifers. If found to be negative, they were inseminated when observed in heat in the next cycle or detected by bull mounting procedure. Data was statistically analyzed by SAS software, version (9.1) of the SAS system for window copy right 2011, SAS Institute Inc., Cary, NC, USA. Data is expressed as Mean ± SE and analyzed by ANOVA, Results exhibiting significant effect were compared by the least significant difference pair wise multiple comparison test. Difference was considered statistically significant at $P<0.05$. All animals – based procedure were in accordance with the "Guidelines for the care and use of Experimental Animals" under the Ethic's committee formulated by the Institute.

RESULTS

Average body weight of calves at the beginning of the study (nine months) was 110 kg, The range for ADG was 250-275 g/d. After sixty days of supplementation of fermented yeast culture to LBW Murrah buffalo calves, a significant increase ($P<0.05$) in Mean± SE of plasma IGF I concentration (42.63 ± 0.84 vs 58.32 ± 0.45 ng/ml) was observed between the groups. Supplementation for further sixty days, the concentration of plasma IGF I increased significantly ($P<0.01$) from the concentration recorded at thirty days of supplementation (42.63 + 0.84 vs 70.23 ± 0.41). In the control group the plasma IGF I concentration increased significantly ($P<0.05$) at 60 days with no further significant increase till 120 d of experiment. A significant difference ($P<0.05$) was observed between groups (Table-1). Similar results were obtained during the tenure for studies on puberty (From fourteen to sixteen months of age, supplementation was discontinued and was initiated to the experimental group from seventeen months (510d) of age for studies on advancement of puberty). These animals which attained puberty at an early age, their BW increased linearly with plasma IGF I concentration. The level of plasma IGF-1 in control group ranged between 70.00 – 79.23 mg/ml whereas in exptal. group it ranged between 74.02 – 89.64 mg/ml (Table-1) when estimated for animals ranging in age from 540d till puberty. The increase in concentration of plasma IGF I, 4 weeks proceeding puberty was significantly more ($P<0.05$) when compared with the concentration during 8 weeks from the initiation of the experiment. Similarly the Mean ± SE for ADG was significantly different ($P<0.05$) between control and experimental group (Table -3) during 150 d of study on calves growth rate (Table-3). The ADG Least square mean value in BW resulted in an increase in body weight of control group by 19.40 ± 1.45 Kg and 26.6 ± 1.45 Kg in the supplemented group of Murrah calves. An ADG of 633 g/animal in control group could be easily achieved under, proper care of individual calves. But supplementation of fermented yeast culture could increase the potential of ADG to 887 g/animal which strongly paralleled with the increase in plasma IGF I in the experimental group (Table-1&3). Whereas the concentration of plasma Hp was not significantly different between the two groups throughout the course of the study and was within the physiological range <500ng/ml (Table 1). During 24 weeks/six months of study, The intitial weight of the animals at the beginning of the experiment and the final weight of the animals at the end of the experiment is given in Table-3. The ADG in BW was observed to be significantly more ($P<0.05$, Table-3) when compared with the ADG of the non-supplemented group (685± 2.45g vs 405 ± 1.25 g). In the control group, the increase in the concentration of plasma IGF I was not significant. There was no significant difference in DMI between the groups but feed conversion efficiency was significantly greater ($P<0.05$) for experimental group.

TABLE 1: Effect of supplementation of fermented yeast culture on level of plasma IGF I and Haptoglobin in female Murrah buffaloes

Days(age)	300	330	360	390	420	510	540	570	600	630	660
Conc. of plasma IGF I(ng/ml)											
CONTROL	40.52	48.23	52.96	52.36	53.98	76.12	72.25	70.32	70.24	69.54	74.28
(Mean ± SE)	± 0.52	± 0.49	±0.23	± 0.36	± 0.45	± 0.25	± 0.32	± 0.28	±0.31	± 0.24	± 0.25
LSM±SE		50.94±2.04						73.27± 0.64			
EXPTAL.	42.63	48.78	58.32	64.52	70.23	82.21	82.52	80.51	81.39	83.39	85.45
(Mean ± SE)	± 0.48	±0.45	±0.38	± 0.43	± 0.41	± 0.3	± 0.22	± 0.19	±0.36	± 0.34	± 0.28
LSM± SE		59.69± 2.04 *						82.07± 0.78 *			
Conc. of plasma HP. (ng/ml)											
CONTROL	502.32	450.14	412.32	398.25	300.2	429.12	450.63	422.36	389.72	400.85	456.32
(Mean ±S E)	± 19.1	± 21.1	±16.3	±17.8	±13.6	± 20.1	± 16.3	± 10	±12.5	± 12.0	± 11.8
LSM ± SE		412.64 ± 12.36						419.36 ±11.23.			
EXPTAL.	489.36	400.23	328.12	300.15	322.15	356.12	400.23	458.36	389.72	482.36	300.58
(Mean ± SE)	± 14.5	±16.3	± 12.5	± 10.6	± 12.0	± 12.2	± 23.0	± 14.5	± 12.3	± 10.2	± 14.3
LSM ± SE		350.54±12.36*						422.21±11.23*			

CONTROL- group without supplementation, EXPTAL- group with supplementation,*P<0.05
LSM-Least square means, 300d- ten months, 420d-fourteen months, 510d- 17 months, 660d- 22months

TABLE 2: Effect of supplementation of fermented yeast culture on feed conversion ratio(FCR) and efficiency (FCE) in female Murrah buffaloes

Days(age)	300	330	360	390	420	510	540	570	600	630	660
FCR											
CONTROL	9.3	11	13.8	12	11.6	6.78	5.68	7.01	8.16	8.2	6.7
Mean±SE	±0.62	±0.52	±0.63	±0.42	±0.8	±0.53	±0.56	±0.45	±0.44	±0.52	±0.62
Mean±SEM		11.54 ± 0.74 *					7.09±0.67				
EXPTAL.	9.8	8	7.9	8.5	8.3	5.73	4.57	6.43	7.82	5.72	4.96
(Mean±SE)	±0.72	±0.62	±0.49	±0.52	±0.41	±0.42	±0.44	±0.56	±0.48	±0.52	±0.36
Mean±SEM		8.3 ± 0.38					5.87±0.85				
FCE											
CONTROL	10.7	9.08	7.2	8.27	8.59	14.72	17.6	14.24	12.24	12.19	14.87
Mean±SE	±0.98	±0.82	±0.65	±0.74	±0.62	±0.56	±0.58	±0.59	±0.42	±0.48	±0.51
Mean±SEM		8.76 ±0.57					14.31±1.6				
EXPTAL.	10.12	12.44	13.9	11.6	12	17.42	21.87	15.53	12.78	17.46	20.16
(Mean±SE)	±1.02	±0.82	±0.79	±0.74	±0.85	±0.32	±0.38	±0.42	±0.51	±0.39	±0.40
Mean±SEM		12.02 ±0.61*							17.54±1.8		

CONTROL- group without supplementation, EXPTAL- group with supplementation,
LSM-Least square mean, BWG-body weight gain, ADG-average daily gain, *P<0.05
300d- ten months, 420d-fourteen months, 510d- 17 months, 660d- 22months

TABLE 3: Effect of supplementation of fermented yeast culture on different body weight parameters in female Murrah buffaloes

Days(age)	300	330	360	390	420	510	540	570	600	630	660
BODYWEIGHT(KG.)											
CONTROL	136	165	150	185	205	284	306	315	339	354	372
MEAN±SE	±2.42	±2.12	±2.00	±1.95	±2.05	±1.5	±3.2	±2.5	±2.4	±4.2	±2.8
LSM±		168±5.02					328±6.02				
EXPTAL.	130	156	185	208	235	310	333	352	367	389	414
MEAN±SE	±3.0	±3.12	±2.51	±3.12	±2.56	±2.4	±3.5	±3.7	±5.4	±2.6	±3.0
LSM±SE		187±5.02 *					361±5.23 *				
BWG (KG)											
CONTROL	16	19	15	22	23	19	22	17	14	15	18
MEAN±SE	±0.98	±1.02	±1.13	1.02	0.96	±2.3	±3.2	±1.8	±1.5	±3.1	±2.5
LSM±SE		19 ±1.45					16±1.62				
EXPTAL.	15	26	29	28	32	23	28	19	15	22	25
MEAN±SE	±0.88	±1.23	±1.22	±1.14	±1.01	±2	±1.3	±4.2	±2.1	±2.2	±2.8
LSM±SE		26 ±1.45 *					24±1.62*				
ADG(g/day)											
CONTROL	0.53	0.63	0.50	0.73	0.77	0.30	0.67	0.57	0.47	0.50	0.47
MEAN±SE	±0.05	±0.03	±0.04	±0.03	±0.02	±0.02	±0.03	±0.02	±0.03	±0.02	±0.01
LSM±SE		0.663 ±0.05					0.405±0.042				
EXPTAL.	0.5	0.87	0.97	1.03	1.07	0.76	0.93	0.63	0.50	0.67	0.85
MEAN±SE	±0.04	±0.03	±0.03	±0.04	±0.04	±0.03	±0.03	±0.02	±0.01	±0.02	±0.01
LSM±SE		0.887 ± 0.05 *						0.685±0.04*			

CONTROL- group without supplementation, EXPTAL - group with supplementation
LSM-Least square mean, BWG-body weight gain, ADG-average daily gain, *P<0.05
300d- ten months, 420d-fourteen months, 510d- 17 months, 660d- 22months

The results of feed conversion ratio (FCR) and feed conversion efficiency (FCE) are presented in Table-2. They attained puberty at the age ranging from 20-24 months, in the experimental group of animals. The control group animals attained puberty ranging between 28-32 months of age. The percentage of heifers reaching puberty during six months of study tenure in the supplemented group was 100% (10/10) and 0% (0/10) in the control group. The animals which attained puberty the plasma progesterone concentration in the three consecutive blood samples was >0.9ng/ml. In the supplemented group 50% conceived to first service and rest to the second service whereas the results for control group 10% of the heifers conceived to first service and 30% to the second service and rest of the heifers conceived to third or more number of services.

DISCUSSION

Supplementation of *Saccharomyces cerevisiae* to calves improved feed intake/live weight gain and decreased effect of transport stress. (Fallon and Harte, 1987; Hughes, 1988; Anand Laxmi *et al*., 2012). The present study is an attempt to establish the circulatory level of plasma IGF I and Haptoglobin in low body weight Murrah buffalo calves. It was also to assess, if supplementation of commercially available fermented yeast culture, Diamond V XP along with diet could improve the circulatory plasma IGF I concentration with an increase in the body weight gain and augment or advance the age at puberty in female Murrah heifers and the possibility of using IGF I as a marker for growth performance under tropical conditions. A strong positive correlation has been reported between ADG, age and plasma IGF I (Torrentera *et al*., 2009). Feed efficiency is an important parameter to identify cattle that are more economic to produce (Lancaster *et al*., 2008) and IGF I has been attributed a role in nutrient utilization (Moore *et al*., 2005). Improved management and minimum disease prevalence can be helpful in reducing age at first calving. ADG was positively related with serum IGF I concentration which increased in growing cattle (Govoni *et al*., 2002). Average age of puberty reported in buffalo and cow heifers is 37 and 34 months (Bashir, 2006). Report on growth rates of Murrah buffaloes are scanty (Kumaravel *et al*., 2004; Thiruvenkadan *et al*., 2009). The significant increase in the body weight of calves during growth phase might have increased IGF I levels and advanced the age of puberty. It was suggested by Bhatti *et al*. (2007) that under tropical conditions forage along with concentrates and other performance modifiers should be supplemented to gain a faster growth rate to attain early puberty. The involvement of IGF I with respect to attainment of puberty and growth performance has not been studied in female buffaloes. Reports of Jones *et al*. (1991) in Angus heifers state that serum concentration of IGF I increased at the onset of puberty and reports of Granger *et al.* (1989) reveal that supplement added to diet advanced the age at puberty when compared with the heifers offered feed without supplement. Age at puberty has been demonstrated to be negatively associated with concentration of IGF I (Radcliff, 2004). Bossis *et al.* (2000) observed a positive correlation between serum concentration of IGF I and estradiol and resumption ovarian activity. Level of plasma Haptoglobin with in physiological range indicates that the subjects are not suffering from any inflammatory conditions as reported by Humblet *et al*. (2004) and Nazifi *et al*. (2006). This study emphasizes the use of IGF I as a marker for growth and reproductive performance in female Murrah buffaloes and supplementation of fermented yeast culture as an economic and non invasive biotechnological tool for increasing productive performance of low body weight female Murrah buffalo calves. This is an important step in the utilization and increasing the productive performance of low body weight Murrah calves.

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