Original Research

Effect of Age at Calving and Lactation Order on Milk Yield Per Kg of Live Body Weight in Murrah Buffaloes Under Organized Farm Conditions

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Abstract

The present study has been conducted on 23 years data (1996 to 2018) pertaining to 1223 lactations of Murrah buffaloes under suckling system of calf rearing at Cattle and Buffalo Farm (Livestock Production and Management Section), ICAR-Indian Veterinary Research Institute, Izatnagar (Bareilly), Uttar Pradesh, India. The milk yields per kg of live body weight (MY/BW) were estimated by dividing monthly milk yields (MMY) in a lactation by respective average monthly live body weights (MLB) of milch buffaloes during 1-13th months of lactation. The effect of age at calving was studied by forming five age at calving classes (ACC1: ≤1095 d; ACC2: 1096-1460 d; ACC3: 1461-1825 d; ACC4: 1826-2190 d and ACC5: ≥2191 d) and lactation orders considered were 1st to 11th lactations. Mostly significant differences (P≤0.01/0.05) were observed for milk yields per kg of live body weights along with monthly milk yields and monthly body weights of Murrah buffaloes for various age group classes and lactation orders.

Key words: Age at Calving, Lactation Order, Milk Yield Per Kg of Live Body Weight, Murrah Buffalo

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Introduction

As India is deficit of green fodder (35.6%), dry fodder (10.95%) and concentrate (44%, Vision, 2030, IGFRI). The unavailability of feeds and fodder resources accounts a huge loss in livestock production. These constituent grains in livestock feeds may prove a boon for almost 30% human population termed as BPL (http://www.businesstoday.in), if non-conventional feeds and fodder resources are replacing these constituent grains in livestock diet or if at all the consumption has been simulated with availability. As the geographical land resources are limited and fixed, the supply of feed has always remained short of normal requirements (Singh and Mujumdar, 1992). Usually, milch buffaloes are selected based on their lactation yields ignoring live body weights. However, live body weight plays an important role in economical production of unit milk as heavier cow/buffalo require larger quantity of dry matter as compared to their lighter counterparts. Therefore, the present study was conducted to assess and evaluate the milk production efficiency of Murrah buffaloes based on milk yield per kg live body weight (derived by dividing monthly milk yields by respective monthly live body weights) in spite of total milk yield and the effect of age at calving classes and lactation order on it in Murrah buffaloes.

Materials and Methods

The present study has been conducted on 23 years data (1996 to 2018) pertaining to 1223 lactations of Murrah buffaloes under suckling system of calf rearing at Cattle and Buffalo Farm (Livestock Production and Management Section), ICAR-Indian Veterinary Research Institute, Izatnagar (Bareilly), Uttar Pradesh, India. The relevant data on monthly milk yields (MMY) – based on pail yields (without making any correction for milk suckled by calves during lactation) and monthly live body weights (MLB) were collected from the records available as well as on the current milch buffaloes. Usually, 319 kg milk is added to the pail yields in a normal lactation, where calves are weaned at around 7 months of age and on an average, they consume 1.52 kg milk/day during suckling period. The milk yield per kg of live body weights (MY/BW) during 1^{st} to 13^{th} month of lactation in Murrah buffaloes were estimated by dividing monthly milk yields in a lactation by respective average monthly live body weights of milch buffaloes. The effects of age at calving class and lactation orders were studied by forming five age at calving classes (ACC 1: ≤1095 d; ACC 2: 1096-1460 d; ACC 3: 1461-1825 d; ACC 4: 1826-2190 d and ACC 5: ≥2191 d) and arranging data as per lactation orders (1-11). The standard analytical procedures were adopted for analysis of generated a data under study by using standard methodology with IBM SPSS 22.0 (Statistical Package for Social Sciences, 2013) software.

Results and Discussion

The overall means for milk yield per kg live body weight (MY/BW) during $1\text{-}13^{th}$ months were 173.51±8.57, 426.01±15.46, 428.53±7.09, 414.54±4.55, 384.08±4.49, 355.22±4.06, 313.67±4.23, 280.78±7.34, 243.06±7.45, 211.38±18.81, 161.81±7.01, 165.00±8.86 and 137.17±10.81 g/kg, respectively. The overall means for monthly milk yield (MMY) during $1\text{-}13^{th}$ months were 90.85±2.16, 215.50±2.70, 227.97±2.37, 221.16±2.17, 203.44±2.06, 184.06±1.89, 162.06±1.85, 141.46±1.85, 118.21±1.89, 95.15±1.99, 70.38±2.24, 54.92±2.79 and 34.23±2.72 kg, respectively. The overall means for monthly body weight (MBW) during $1\text{-}13^{th}$ months were 588.47±3.89, 576.79±8.85, 567.49±7.64, 564.64±7.52, 570.85±10.45, 574.75±11.79, 566.47±2.91, 577.97±10.86, 571.92±3.51, 581.44±3.57, 587.97±3.79, 595.15±4.05 and 615.04±11.75 kg, respectively (Table 3). The age at calving class (ACC) expressed its significant affect (P≤0.01/0.05) on MY/BW during 1^{st} to 8^{th} and 11^{th} months. Highest values for MY/BW

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were observed in 4th age at calving class for early, 2nd and 3rd ACC for mid and 1st age at calving class for late months of lactation. The MY/BW increased from ACC l-3/4, beyond which it gradually decreased (Table 1, Fig. 1).

Table 1: Age at calving class wise means for milk yield per kg of live body weights in Murrah buffaloes

Particulars	**Milk Yields per kg of Live Body Weights (g/kg) During Months**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Age at Calving Classes	**	**	*	**	**	**	**	*	NS	NS	**	NS	NS
ACC1 (≤1095 d)	136.95± 19.34 (45)	366.76± 23.50 (38)	414.63± 19.98 (35)	429.73± 17.48 (39)	392.04± 19.30 (38)	390.9±1 6.95 (35)	345.26± 19.79 (32)	299.01 ±18.79 (31)	277.12 ±17.04 (27)	218.59 ±20.16 (23)	218.94± 33.47 (20)	214.54± 21.51 (11)	179.98 ±27.51 (9)
ACC 2 (1096-1460 d)	130.86± 11.05 (111)	352.72± 14.69 (95)	391.86± 15.01 (88)	404.02± 11.33 (89)	388.62± 11.61 (80)	365.36± 10.01 (82)	329.42± 11.27 (74)	332.3± 43.51 (74)	249.91 ±10.23 (75)	201.11 ±11.54 (61)	166.63± 16.43 (45)	148.79± 16.62 (24)	134.83 ±24.91 (12)
ACC 3 (1461-1825 d)	219.54± 52.50 (76)	430.91± 16.72 (74)	465.48± 14.27 (77)	457.31± 13.09 (74)	427.14± 12.85 (72)	390.14± 11.63 (65)	345.51± 11.07 (60)	293.38 ±8.96 (83)	246.85 ±11.45 (77)	226.38 ±13.13 (60)	163.23± 15.63 (46)	177.59± 24.47 (21)	178.79 ±38.82 (10)
ACC 4 (1826-2190 d)	229.26± 36.80	574.72± 101.19 (61)	472.45± 15.01 (60)	462.81± 13.14 (55)	408.87± 12.76 (64)	380.17± 10.24 (68)	325.61± 12.29 (61)	287.24 ±12.97 (59)	259.01 ±49.54 (51)	190.12 ±16.65 (35)	209.13± 26.72 (27)	185.83± 16.54 (15)	107.47 ±46.08 (4)
ACC 5 (≥2191 d)	171.32± 6.90 (339)	425.37± 19.65 (338)	423.2±1 0.90 (332)	397.59± 5.95 (323)	367.71± 5.86 (327)	335.46± 5.43 (306)	297.06± 5.48 (290)	259.45 ±5.77 (272)	231.63 ±8.38 (222)	213.03 ±36.49 (184)	139.29± 8.80 (120)	152.78± 14.78 (60)	115.36 ±12.53 (30)

$**P\leq0.01$, $*P\leq0.05$, NS-non-significant

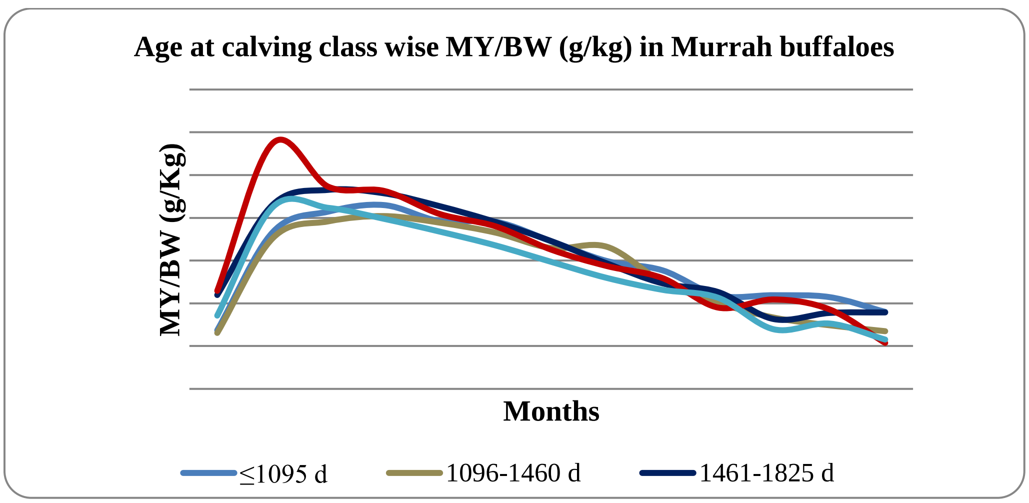

Fig. 1: Age at calving class wise means for MY/BW in Murrah buffaloes

The lactation order (LO) also expressed significant affect (P≤0.01/0.05) on most of the MY/BW (early and mid-months in lactation i.e. month 1-7). Highest values for MY/BW observed in 2nd (months 4-7) and 3rd lactations (months 1-3) beyond which almost gradual declining trend was observed over lactation orders (up to 11th LO). Within months, the MY/BW progressively increased from 1st to 3rd LO and then it tends to decrease gradually towards the 11th LO. Hence, the lowest values for MY/BW were observed in the 11th

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LO (Table 2, Fig. 2) may be due to gradual increase in MBW from 1st-11th Lo due to aging and gradual decline in MMY over lactations.

Table 2: Lactation order (LO) wise milk yields per kg live body weight (g/kg) in Murrah buffaloes

Particulars	Milk yields per kg live body weights (g/kg) during months												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Lactation Order	NS	*	**	**	**	**	**	NS	NS	NS	NS	NS	NS
1	131.265	353.104	391.688	402.342	390.575	370.201	330.471	318.339	255.306	209.163	177.892	155.957	162.702
	±9.384	±11.512	±11.657	±9.845	±9.197	±8.402	±9.590	±27.528	±8.339	±9.460	±13.526	±13.743	±17.568
	(162)	(138)	(130)	(134)	(126)	(123)	(112)	(119)	(116)	(98)	(79)	(40)	(21)
2	210.662	442.955	477.066	461.088	420.092	386.517	345.768	291.045	233.544	217.282	155.667	187.387	167.747
	±41.733	±16.091	±11.324	±11.101	±11.673	±9.695	±9.761	±9.132	±10.668	±11.398	±14.561	±20.936	±38.432
	(97)	(93)	(93)	(91)	(95)	(91)	(82)	(97)	(89)	(67)	(50)	(24)	(11)
3	223.487	514.571	485.536	439.629	393.463	376.143	326.382	287.784	277.269	310.878	173.799	179.945	107.498
	±25.893	±65.653	±29.629	±10.658	±11.478	±8.914	±9.852	±9.660	±38.081	±130.147	±23.274	±32.724	±36.423
	(96)	(95)	(98)	(92)	(97)	(96)	(86)	(81)	(66)	(51)	(35)	(19)	(5)
4	180.44	425.165	433.567	417.986	373.477	350.89	309.415	274.287	246.824	172.452	160.734	163.41	143.438
	±14.609	±14.860	±15.853	±13.397	±13.007	±10.048	±12.517	±13.548	±15.411	±15.507	±21.145	±31.682	±26.503
	(80)	(81)	(74)	(70)	(77)	(68)	(69)	(59)	(52)	(49)	(30)	(15)	(7)
5	177.022	468.573	404.874	388.334	370.553	327.266	286.663	241.46	207.785	167.511	129.008	150.395	111.225
	±15.392	±69.156	±12.197	±11.497	±11.894	±12.575	±11.426	±12.944	±14.694	±16.423	±23.078	±26.604	±31.718
	(69)	(70)	(70)	(69)	(64)	(61)	(54)	(54)	(41)	(31)	(15)	(8)	(5)
6	163.32	489.66	430.253	403.447	377.538	335.955	300.636	279.103	215.681	189.408	155.849	125.802	104.291
	±18.249	±88.947	±27.164	±15.030	±14.433	±17.310	±13.590	±14.853	±20.031	±17.239	±22.849	±31.471	±23.899
	(47)	(46)	(47)	(47)	(47)	(47)	(43)	(41)	(33)	(23)	(17)	(11)	(5)
7	183.448	380.099	378.227	387.575	349.024	304.413	271.117	245.641	207.121	178.761	125.825	170.367	67.157
	±21.007	±19.818	±22.956	±18.085	±15.924	±13.835	±16.066	±14.060	±15.987	±14.049	±22.500	±23.942	±16.961
	(39)	(38)	(38)	(37)	(37)	(34)	(34)	(33)	(29)	(21)	(16)	(6)	(4
8	135.044	367.044	390.188	390.391	338.502	300.665	264.815	220.6	275.992	160.675	140.668	186.736	105.49
	±20.626	±23.846	±20.907	±18.905	±23.508	±17.075	±17.886	±17.527	±70.785	±21.399	±29.611	±23.958	±27.972
	(27)	(25)	(26)	(24)	(23)	(23)	(24)	(23)	(17)	(15)	(11)	(6)	(5)
9	111.63	305.49	366.62	355.3	340.84	301.89	281.65	220.77	214.53	200.07	172.16	148.66	119.54
	±20.12	±36.40	±30.01	±34.71	±23.15	±22.80	±18.83	±45.69	±38.42	±20.92	±44.57	±12.94	±110.37
	(14)	(14)	(12)	(11)	(11)	(9)	(9)	(8)	(7)	(7)	(5)	(2)	(2)
10	125.024	283.383	322.132	309.617	331.439	294.863	225.732	173.093	321.875	256.25			
	±28.854	±61.420	±104.501	±58.177	±61.290	±49.358	±49.143	±76.881	(1)	(1)	-	-	-
	(4)	(5)	(3)	(4)	(3)	(3)	(3)	(3)					
11	8.333	280.833	289.474	241.071	201.77	205.455	189.286	171.681	171.053				
	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-	-	-	-

***P≤0.01, *P≤0.05, NS-non-significant*

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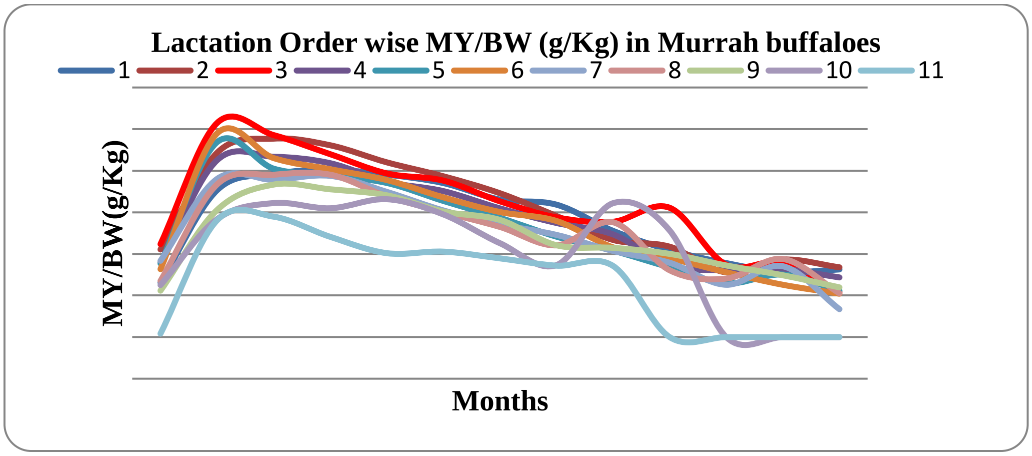

Fig. 2: Lactation order wise means for MY/BW in Murrah buffaloes

The MY/BW showed higher values in initial ages (ACC and LO) which may be due to the fact that at early calving ages (may be initial lactations), the live body weights were comparatively smaller and the milk yields were comparatively better. In later ages/calving classes, MY/BW decreased due to gradual increase in live body weights. Hence, small buffaloes may be economical up to 3/4 (1461-1825 /1826-2190 d) age at calving, at which they possessed smaller live body weight with higher milk efficiency, which would be more economical and profitable for rearing dairy buffaloes. McDaniel and Legates (1965) also reported that the milk yield can be improved without increasing body weight of dairy cattle.

Monthly milk yields (MMY) and monthly live body weights (MBW) represented similar patterns to explain the trend shown by MY/BW (Fig. 3). Higher values for MMY were observed in ACC 4-5. The MMY's increased from 1-3/4th month, beyond which gradual decline was there. It indicated that whatever be the age at calving, MMY's increased from 1st to 3/4th month showing highest MMY during 3-4th month. ACC class wise, the individual MMY's expressed almost gradual increasing trend from ACC 1-4 indicating that maximum MMY's were shown at a calving age up to 2190 d (whatever the LO), except MMY2, which was maximum in ACC-5 (≥ 2191 d). Tomar and Joshi (1995) observed positive genetic correlations of total lactation milk yield with age at second calving. Whereas, in case of monthly live body weights (MBW), it was observed that the MBW's decreased from 1st month of calving to almost 5-6th month (may be due to production stress), beyond which it started increasing up to 13th month either may be due to simultaneous decrease in MMY's or due to growing foetus (in case of later months of pregnant Murrah buffaloes). The significant effects (P≤0.01/0.05) of ACC on MBWs clearly indicated that in all months of different age at calving classes, MBW increased from ACC 1-5 may be due to the fact that with the progress of ACC, the Murrah buffaloes gradually became heavier.

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Table 3: Overall means of monthly body weight, monthly milk yield, and milk yield per kg live body weight in Murrah buffaloes

Particulars	Monthly overall mean (μ)in the lactations												
	1	2	3	4	5	6	7	8	9	10	11	12	13
MY/BW (g/kg)	173.51	426.01	428.53	414.54	384.08	355.22	313.67	280.78	243.06	211.38	161.81	165	137.17
	±8.57	±15.46	±7.09	±4.55	±4.49	±4.063	±4.23	±7.34	±7.45	±18.81	±7.01	±8.86	±10.81
	(636)	(606)	(592)	(580)	(581)	(556)	(517)	(519)	(452)	(363)	(258)	(131)	(65)
MBW (Kg)	588.47	576.79	567.49	564.64	570.85	574.75	566.47	577.97	571.92	581.44	587.97	595.15	615.04
	±3.89	±8.85	±7.64	±7.52	±10.45	±11.79	±2.91	±10.86	±3.51	±3.57	±3.79	±4.05	±11.75
	(643)	(648)	(659)	(658)	(664)	(650)	(609)	(609)	(567)	(543)	(510)	(471)	(453)
MMY (Kg)	90.85	215.5	227.97	221.16	203.44	184.06	162.06	141.46	118.21	95.15	70.38	54.92	34.23
	±2.16	±2.70	±2.37	±2.17	±2.06	±1.89	±1.85	±1.85	±1.89	±1.99	±2.24	±2.79	±2.72
	(1223)	(1160)	(1110)	(1085)	(1068)	(1035)	(1012)	(993)	(940)	(825)	(647)	(441)	(318)

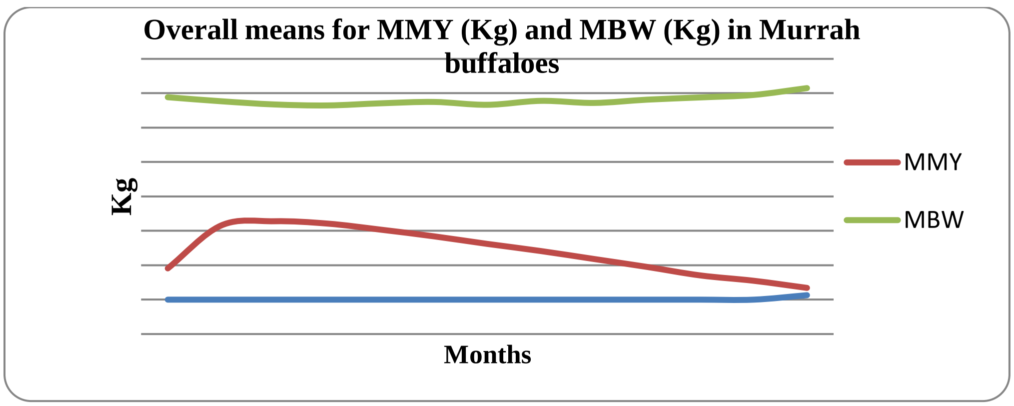

Fig. 3: Overall means for MMY and MBW in Murrah buffaloes

Most of the highest values for MBW's were seen in 5th age at calving class and lowest in 1st ACC. Live body weight increased as the age at calving class increased. This is in agreement with Oni *et al.* (2001), who observed the significant effect of parity on body weight. He further reported that the post-partum body weights increased with parity. It was also observed that in early months of lactations, the MBW's were decreasing and MMY's were increasing which resulted in simultaneous increase in MY/BW. In later stages of lactation, after 4/5th month, both the traits MBW's and MMY's showed opposite trend i.e. MBW's were increasing and MMY's were decreasing steadily. Such trend of MBW's and MMY's ultimately resulted in decreased MY/BW values in later stages of lactations (Fig. 3).

As the lactation enhances, the live body weight regresses due to mobilization of adipose tissue in early lactation in dairy animals (Garnsworthy, 1988 and Nebel and McGilliard, 1993). Hence, there is weight loss in milking animals just after calving during initial months of lactation. The profitability of Murrah buffaloes reared for milk production is maximum at 3rd/4th ACC (1461-1825 /1826-2190 d) based on

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MY/BW values, beyond which, it gradually decreased. Lactation order also showed enhanced milk production efficiency up to 3rd lactation beyond which it decreased. It may be due to the fact that in later stages of production life of Murrah buffaloes (after 3rd/4th ACC), milk yield gradually decreases while the MBW's express a gradual increasing trend. The increase in MBW's may be either due to deposition of muscular body fat or due to slight growth. Such higher live body weights will ultimately demand for greater DM intake in the form of consumption of more feeds and fodder, with lowered milk yields, which may not be profitable for buffalo owners. Genetically heavier buffaloes require more feeds and fodder, which would not be economical for dairy farmers.

This finding is in close agreement with the report of Veerkamp (1998), who observed that there is a high genetic correlation between milk yield and feed intake. The buffaloes with smaller body size may prove beneficial in long term for a country like ours where severe shortage of feeds and fodders for livestock exists along with a considerable proportion of human population living below poverty line. The small sized buffaloes may produce comparatively lesser milk as compared to large sized buffaloes, though the inputs/requirements for smaller buffaloes are also comparatively lower, which makes them efficient producers with consumption of lower feeds and fodder, housing and space and other management practices etc. The reports of Moore *et al.* (1991) were also in agreement with the present findings. They reported that all genetic correlations between weight at first calving and milk yield were negative and their estimates ranged from -0.21 to -0.38 in Ayrshires and from -0.11 to -0.30 in Holsteins. He further reported that genetically heavier cows at first calving would produce lesser milk. From the economic point of view, small dairy animals may be more beneficial than larger ones if feed and fodder resources are limited. Some research workers also reported that small cows are beneficial from economic point view for sustainable production of milk. Gains *et al.* (1940) reported that the smaller cows in a herd or breed, which remain in the herd after culling are more efficient than larger ones. Oni *et al.* (2001) reported negative phenotypic correlations between milk yield and post-partum body weights. Furthermore, larger cows' costs more than smaller ones to maintain due to higher costs required on account of feed and labour etc. (Morrison and Frank, 1956). High yielders are high in weight and are associated with reproductive problems like longer periods to conceive (more services per conception) and associated with longer calving interval (Whitemore *et al.*, 1974).

Conclusion

The age at calving and lactation order had significant effects on milk yields per kg of live body weight in Murrah buffaloes. The Murrah buffaloes reared for milk production were more efficient and economical milk producers at 3rd/4th ages at calving (1461-1825 /1826-2190 d) and 3rd lactation order based on milk yields per kg body weight, beyond which, it gradually decreased.

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