Vol 2 No 1 March 2021 Pages 77-80 e-ISSN 2708-5694

Journal of Agriculture, Food and Environment (JAFE)

Journal Homepage: http://journal.safebd.org/index.php/jafe

http://doi.org/10.47440/JAFE.2021.2113

Original Article

Assessment of growth potentials between indigenous and crossbred buffaloes

M. Shahjahan[1,2]*, A. Khatun[1], S. Khatun[1], S. Hossain[1], Q.M.E. Huque[1]

[1]Lal Teer Livestock Limited, Anchor Tower, 108, Bir Uttam C. R. Dutta Road, Dhaka 1205, Bangladesh
[2]Bangladesh Livestock Research Institute, Regional Station, Baghabari, Sirajganj 6770, Bangladesh

Article History

Received: 03 March 2021

Revised: 18 March 2021

Accepted: 23 March 2021

Published online: 31 March 2021

***Corresponding Author**

M. Shahjahan, E-mail: sajubau@gmail.com

Keywords

Body weight, breeding, growth rate, native, synchronization

A B S T R A C T

The buffalo is considered as fast-growing meat producing animal compare to cattle with lower cholesterol and higher nutrition content. This study was planned to elucidate the variation of body weight and average daily gain in both indigenous and F1 crossbred (Indigenous×Mediterranean) buffalo. Body weight was measured every three months from birth up to yearling stage for both indigenous (28-195 kg) and F1 crossbred (35-220 kg) buffalo progenies during the year 2011-2014. It was observed that body weight of indigenous buffalo significantly (p <0.05) differed in pre-weaning stage for first parity (81 kg) compared to second parity (73 kg) while seasonal variations showed similar differences (p <0.05) in pre-weaning (86 kg in winter) and post-weaning (177 kg in winter) periods. However, there were no significant variations (p >0.05) found for body weight in crossbred buffaloes except differences (p <0.001 to p <0.05) from pre-weaning (110 kg) to post-weaning (207 kg) during the change of year. Significant differences (p <0.05-p <0.01) were observed for the effect of two parities and three seasonal variations at three (566 and 642 g), six (488 and 540 g) and nine (485 and 552 g) months of age in average daily gain of indigenous buffalo progenies, respectively. No significant variations were identified in crossbred progenies excluding year (p <0.001 to p <0.05) while highest average daily gain was found in three (818 g/day), six (600 g/day) and nine (631 g/day) months of age. Crossbred buffaloes were found to be superior compared to indigenous which could be used in the meat industry through a systemic breeding programme.

Introduction

The population of buffalo is about 1.49 million where 40% are found in the coastal areas of Bangladesh (DLS, 2018). The number of buffalo is unsatisfactory because of lower production capacity and predominant use for draft purposes with traditional husbandry practices. Faruque (2003) revealed that the abundance of 0.77 million buffalo population were distributed in the flood plain of Bramhaputra-Jamuna and Ganges-Meghna and different institutional on station farming in which 100,000 buffalo cows used for overall draft or milk purposes.

In a grazing production system, the buffalo is considered as a valuable meat producing animal because of faster growth than *Bos indicus* or *taurus* (Angulo *et al.*, 2006). Although, buffalo meat is better than beef in regard to its lower cholesterol and higher nutrition content (Giordano *et al.*, 2010), it is not as well liked as cattle meat in Bangladesh followed by goat and sheep. Growth rate is highly associated with productive and reproductive traits concerning the economy of meat production but it is a complicated process for linking with genetics, non-genetic factors and their interactions (Agudelo-Gómez *et al.*, 2009).

Therefore, it is important to know the variations of growth traits in buffalo populations. Regarding this aspect, differences of growth traits in body weight and daily average gain between indigenous and crossbred buffalo populations was assessed as first-time study in Bangladesh owned by Lal Teer Livestock Development (BD) Limited (LTLL), one of the promising private research stations.

Materials and Methods

Study areas and data collection

The study was conducted in the research and development (R&D) farm of LTLL located in Uthura, Bhaluka, Mymensingh, Bangladesh from which data of growth traits during 2011 to 2014 were collected from 33 indigenous and 35 crossbred buffalo progenies. Live body weights of indigenous and F1 crossbred buffaloes were measured by

digital weight balance at birth (BW_0), three (BW_3), six (BW_6), nine (BW_9) and twelve months (BW_{12}) of age. Growth rates were derived as average daily gain at three (ADG_{0-3}), six (ADG_{0-6}), nine (ADG_{0-9}) and twelve months (ADG_{0-12}) of age. The birth seasons of buffalo progenies were categorized into summer (March to June), rainy (July to October) and winter (November to February).

Management of buffaloes

The buffaloes were kept in face-in housing system with paved floor and 3.3 ft apart from each individual. Feeding system (2.5% of body weight as dry matter) was similar for all the studied population except few variations in the production of seasonal and perennial fodder, type of supplied straw, temperature, rainfall and disease incidences. The indigenous and crossbred buffalo progenies were originated from the semen of two indigenous buffaloes and straws of five imported sires (Indigenous×Mediterranean).

Statistical analysis

The significance of different fixed factors was tested by the general linear model (GLM) procedure under RBD experimental design of the statistical analysis system (SAS) version 9.1.3 (SAS Institute Inc., Cary, NC, USA) including two sample *t* hypothesis tests (both independent and paired). The descriptive statistics and mean separation were calculated using statistical package for the social sciences (SPSS) version 16.0 (SPSS Inc., Chicago, IL, USA) with Tukey's HSD mean separation *post hoc* test. The statistical model was:

$$Y_{ijklm} = \mu + P_i + G_j + S_k + T_l + e_{ijklm}$$

Where:

Y_{ijklm}; the dependent variable

μ; the overall mean

P_i; the fixed effect of i^{th} parity

G_j; the fixed effect of j^{th} sex

S_k; the fixed effect of k^{th} seasonal effect

T_l; the fixed effect of l^{th} year

e_{ijklm}; the residual error

Results and discussion

Comparison between body weights

The body weights of indigenous and F1 crossbred buffaloes are presented in Table 1 and Table 2, respectively. The average birth weight of indigenous and crossbred progenies were 28 and 35 kg, and were not significantly affected by the factors examined as dam parity, calf sex, season or year of birth. In pre-weaning stage for indigenous calves, parity and season had significant (p <0.05) effects on body weights at three months of age (average 77 kg). These data showed that body weights were higher in first parity than second and also for calf born in winter than the rainy or summer seasons. Weights of crossbred calves were affected by year of calving. At weaning (6 months), body weight of local calves averaged 113 kg and were affected by season of birth (p=0.06) with calves born in winter being heaviest at weaning. Seasonal effects observed (p=0.04) for body weight changing at nine months in indigenous progenies at winter by 177 kg than 142 kg in rainy and 134 kg in summer seasons. The above findings suggested that body weights of indigenous and crossed buffalo populations were varied by the effects of both environment and genetics.

Table 1. Effect of different factors on body weight of indigenous buffalo

Factors	n	Mean±SEM				
		BW_0	BW_3	BW_6	BW_9	BW_{12}
Parity						
First	19	29.68±1.08	80.63±3.65	118.53±5.40	151.00±5.53	188.26±8.88
Second	14	25.93±2.07	72.57±4.98	106.50±7.40	156.79±14.73	203.86±19.25
P value		0.478	0.048	0.075	0.074	0.212
Sex						
Male	18	28.56±1.43	79.83±4.95	119.56±6.81	163.44±11.06	206.56±13.11
Female	15	27.53±1.76	74.07±2.95	106.07±5.11	141.47±6.51	180.87±13.52
P value		0.887	0.295	0.698	0.949	0.929
Season						
Summer	10	27.30±1.54	67.50^{b}±4.43	99.60±7.06	134.10^{b}±8.37	161.70±10.87
Rainy	10	29.10±1.92	75.80^{ab}±3.78	110.50±5.48	142.10^{b}±9.50	184.70±16.13
Winter	13	27.92±2.16	85.80^{a}±5.45	126.31±7.93	177.08^{a}±12.29	228.23±15.15
P value		0.861	0.030	0.060	0.036	0.108
Year						
2011	13	25.92±2.23	72.38±5.37	105.54±7.94	149.23±13.67	197.08±19.46
2012	4	29.00±1.78	98.25±8.29	148.50±11.82	199.25±18.95	241.00±18.81
2013	7	30.57±2.10	79.29±6.51	119.29±7.31	153.14±10.87	201.29±17.53
2014	9	28.89±1.57	73.22±1.84	104.67±3.20	139.44±4.50	166.22±7.36
P value		0.672	0.531	0.417	0.308	0.337
Overall	33	28.09±1.11	77.21±3.02	113.42±4.47	153.45±6.90	194.88±9.55

BW_0=Body weight at birth, BW_3=Body weight at three month, BW_6= Body weight at six month, BW_9= Body weight at nine month, BW_{12}= Body weight at twelve month and SEM=Standard error of mean

Table 2. Effect of different factors on body weight of the F1 buffalo (Indigenous×Mediterranean)

Factors	n	Mean±SEM				
		BW_0	BW_3	BW_6	BW_9	BW_{12}
Parity						
First	28	35.04±0.92	96.54±2.89	145.93±4.71	184.29±5.47	220.50±6.85
Second	7	35.14±1.94	94.00±7.20	137.00±8.07	170.29±11.65	216.50±17.28
P value		0.459	0.704	0.711	0.722	0.530
Sex						
Male	19	35.53±1.08	96.37±3.29	144.26±4.58	184.16±4.91	212.53±6.64
Female	16	34.50±1.27	95.63±4.49	144.00±7.30	178.31±9.32	217.53±11.70
P value		0.931	0.934	0.777	0.690	0.595
Season						
Summer	7	36.00±1.48	99.43±5.10	142.85±6.93	181.14±6.53	219.43±7.03
Rainy	23	34.70±1.02	97.52±3.06	146.09±5.52	182.39±7.20	222.28±9.41
Winter	5	35.40±2.87	84.40±9.78	137.00±10.48	177.80±7.96	219.70±4.33
P value		0.572	0.316	0.592	0.529	0.548
Year						
2012	12	36.25±1.53	109.75^{a}±3.08	166.75^{a}±6.36	206.58^{a}±8.71	252.42^{a}±11.00
2013	17	34.35±1.00	93.59^{b}±2.73	135.29^{b}±3.63	169.24^{b}±5.17	202.44^{b}±6.72
2014	6	34.67±2.51	75.50^{c}±3.50	124.00^{c}±6.19	166.00^{b}±4.26	203.17^{b}±2.91
P value		0.911	0.001	0.005	0.025	0.019
Overall	35	35.06±0.82	96.03±2.68	144.14±4.10	181.49±4.97	219.70±6.36

BW_0=Body weight at birth, BW_3=Body weight at three month, BW_6= Body weight at six month, BW_9= Body weight at nine month, BW_{12}= Body weight at twelve month and SEM=Standard error of mean

The comparative analysis for body weight in both indigenous and crossbred buffalo progenies revealed increasing trend (p <0.001) between consecutive two periods (Figure 1a). These data suggested that consequence weights were in increasing patterns in both types of buffalo calves with different rates from birth to yearling stages. Body weight in both indigenous and crossbred buffalo calves showed significant variances (Figure 1b).

In Egyptian buffalo progenies (Shahin *et al.*, 2010), the average body weights at birth, three, six, nine and twelve months were recorded as 34, 77, 114, 148 and 179 kg, respectively. These results agreed with our findings for indigenous buffalo progenies, except slightly lower birth weight. In another study, Pandya *et al.* (2015) reported body weights in Indian local Surti buffalo at birth, three, six and twelve months of age were 25, 50, 72 and 130 kg, respectively. The findings of Afzal *et al.* (2009) identified 35 and 37 kg birth weight of Nili-Ravi buffalo progenies in stall feeding and open grazing condition in Pakistan were also agreed with our findings. In Pakistani Nili-Ravi buffalo, birth weight was 36 kg (Akhter *et al.*, 2012) which was similar with our F1 crossbred buffalo progenies, but weaning (66 kg)

and yearling (146 kg) weights of that study were much lower than our findings either in crossbred and indigenous progenies which indicated the effect of breed with better management in stall feeding. The study of Zaba and Clevañer (2001) and Rodas-González *et al.* (2001) found 201 and 235 kg weaning weight of buffalo progenies in Argentina and Venezuela, respectively. These results were much higher than our findings either in indigenous and F1 crossbred progenies. Such findings indicate a beef breeding programme while our breeding programme has focused on developing a dual-purpose buffalo breed.

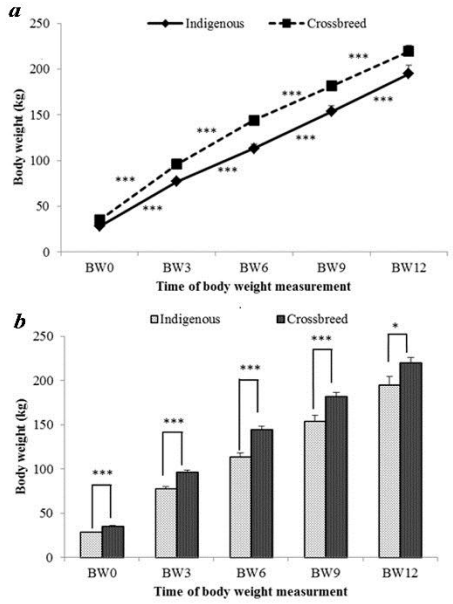

Figure 1. Comparison between body weights for indigenous and crossbred buffalo. Body weight variations from birth to yearling with three months interval in indigenous and crossbred progenies individually (*a*); variation of body weights between two breeds in five weight measuring periods mentioning birth to yearling (*b*). Data are means (n of indigenous = 33 and n of crossbred = 35) + standard error of the mean, except when error bars are smaller than symbols. Consecutive two means of different weight measuring periods on each line with specific mark (*** = $p< 0.001$) differ significantly. Means on each pair of bars with different marks (* = $p< 0.05$, *** = $p< 0.001$) differ significantly.

Comparison between daily gains

Average daily growth rate of indigenous and F1 crossbred buffalo calves are shown in Table 3 and Table 4. Growth rate of indigenous buffalo progenies was 543 g/day and varied ($p <0.05$) with parity and seasonal effects at three months of age while in crossbred calves the average growth rate was 678 g/day. In indigenous calves, growth rate was higher in first parity (566 g/day) than second (519 g/day), and also in winter (642 g/day) than other two seasons. Similar observations were identified in weaning and post weaning stages with the average of 469 and 600 g/day in local, and 464 and 543 g/day in crossbred buffaloes. The growth rate at yearling stage was not varied by the effect of examined factors in two studied breeds except for year of calving (506 g/day) for crossbred.

The average daily gain of crossbred calves showed lower trend ($p <0.001$) between all consecutive two periods (Figure 2a), but growth rate of indigenous buffaloes declined from three to sixth month of age ($p <0.001$) and then remain same up to twelve months. These data indicated that growth rate decreased according to age in crossbred buffaloes but the indigenous progenies retained their growth rates stable in adverse situation of post weaning because of their adaptability for place of origin than crossbred. Growth rate was significantly lower in indigenous calves in all the measuring periods except yearling age (Figure 2b). These results showed that the growth rate of indigenous buffaloes was lower than that of crossbred due to additive genetic effect.

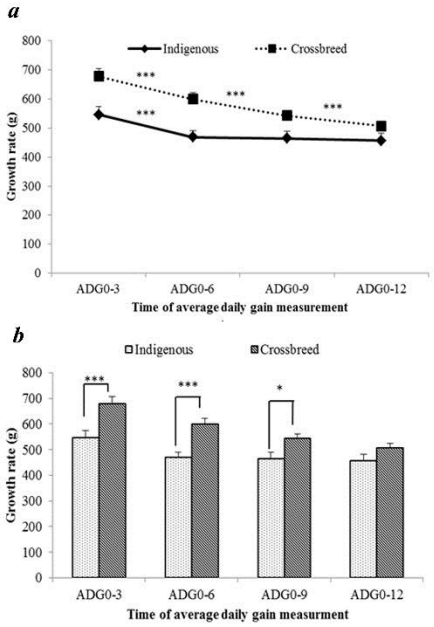

Figure 2. Comparison of average daily gain between growth rates for indigenous and crossbred buffalo. Differences of average daily gain from birth to one year of age with three months interval timing in both indigenous and crossbred buffalo progenies (*a*); variation of average daily gain between two breeds in five weight measuring periods from birth to yearling (*b*)**.** Data are means (n of indigenous = 33 and n of crossbred = 35) + standard error of the mean, except when error bars are smaller than symbols. Average daily gain between two measuring points on each line with specific mark (*** = $p< 0.001$) differ significantly. Means on each pair of bars with different marks (* = $p< 0.05$, *** = $p< 0.001$) differ significantly.

The findings of Afzal *et al.* (2009) indicated 415 and 433 g growth rate per day in Pakistani Nili-Ravi buffalo progenies using stall feeding and open grazing at nine month of age suggesting limited effect of changing feeding systems. The pre-weaning and post-weaning growth rate of Nili-Ravi buffalo progenies were 316 and 301 g/day in Pakistan but those were much lower than our observed growth rate in both indigenous and crossbred buffalo progenies (Akhter *et al.*, 2012) which might be the result of breed and management variation. Their results were slightly agreed with Shahin *et al.* (2010) who mentioned 490 and 380 g/day for pre and post-weaning periods in Egyptian indigenous buffalo progenies, respectively. The significant difference of daily average growth rate in different years reflected the superiority of semen used in AI including slightly variation in the level of management, availability of good quality feed, temperature and humidity. Body weight gain of animals after weaning is a substantial feature for growth evaluation which is not only limited within breed, sex, nutrition etc. but also

the measures of bone growth and body length as those are influenced the growth of organs, muscle, and adipose tissue (Alves and Franzolin, 2015). Campêlo *et al.* (2004) reported that the maternal effect is slowly faded away after weaning and the direct genetic effect contributed more in the growth of the animals thereafter.

Table 3. Effect of different factors on average daily gain of indigenous buffalo

Factors	n	Mean±SEM			
		ADG_{0-3}	ADG_{0-6}	ADG_{0-9}	ADG_{0-12}
Parity					
First	19	565.95±37.26	488.16±28.62	449.32±19.65	434.21±24.72
Second	14	519.14±41.80	442.86±33.21	484.86±50.86	487.57±50.56
P value		0.013	0.040	0.032	0.162
Sex					
Male	18	570.17±45.91	500.28±32.77	499.78±38.61	487.50±35.08
Female	15	517.20±26.05	431.33±24.86	421.93±22.60	420.07±36.73
P value		0.135	0.664	0.972	0.910
Season					
Summer	10	447.50^{b}±40.67	397.80^{b}±33.14	395.70^{b}±27.89	368.50±27.67
Rainy	10	519.40^{b}±39.32	447.50^{ab}±30.79	418.80^{b}±35.60	426.30±46.00
Winter	13	642.46^{a}±43.66	540.15^{a}±35.09	552.31^{a}±40.86	548.31±39.36
P value		0.003	0.020	0.023	0.109
Year					
2011	13	517.23±45.10	437.77±35.45	456.92±45.90	469.00±50.79
2012	4	770.25±77.29	656.50±57.16	630.75±73.31	580.75±55.06
2013	7	540.43±62.81	487.00±36.63	453.86±36.40	467.14±48.99
2014	9	492.56±15.76	416.56±18.78	409.44±18.56	376.22±22.04
P value		0.075	0.118	0.152	0.270
Overall	33	546.09±27.70	468.94±21.70	464.39±24.09	456.85±25.69

ADG_{0-3}=Average daily gain from birth to three month , ADG_{0-6}=Average daily gain from birth to six month, ADG_{0-9}=Average daily gain from birth to nine month, ADG_{0-12}=Average daily gain from birth to twelve month and SEM=Standard error of mean

Table 4. Effect of different factors on average daily gain of F1 buffalo (Indigenous×Mediterranean)

Factors	n	Mean±SEM			
		ADG_{0-3}	ADG_{0-6}	ADG_{0-9}	ADG_{0-12}
Parity					
First	28	683.75±30.90	609.50±25.78	552.93±20.09	508.29±18.41
Second	7	655.57±61.47	560.29±41.12	501.29±38.52	497.29±43.54
P value		0.994	0.870	0.843	0.458
Sex					
Male	19	676.16±34.44	597.37±24.89	550.58±17.29	509.58±16.77
Female	16	680.44±44.68	602.38±39.52	533.13±34.00	501.94±31.62
P value		0.919	0.794	0.693	0.593
Season					
Summer	7	704.71±46.68	587.43±32.50	537.86±21.24	502.71±17.78
Rainy	23	698.96±29.69	612.35±29.51	547.35±26.02	514.22±24.91
Winter	5	545.00±110.42	558.40±66.59	527.40±30.83	473.40±11.10
P value		0.286	0.598	0.538	0.483
Year					
2012	12	818.08^{a}±31.81	717.58^{a}±35.04	631.33^{a}±31.91	592.58^{a}±29.08
2013	17	658.82^{b}±25.16	554.76^{b}±19.55	499.82^{b}±18.98	460.71^{b}±17.91
2014	6	452.83^{b}±33.34	491.00^{b}±40.33	486.33^{b}±13.40	461.67^{b}±5.91
P value		0.000	0.008	0.031	0.020
Overall	35	678.11±27.27	599.66±22.21	542.60±17.92	506.09±16.82

ADG_{0-3}=Average daily gain from birth to three month , ADG_{0-6}=Average daily gain from birth to six month, ADG_{0-9}=Average daily gain from birth to nine month, ADG_{0-12}=Average daily gain from birth to twelve month and SEM=Standard error of mean

Conclusion

It is concluded that crossbred buffalo progenies are superior compared to indigenous regarding body weight and average daily gain. Although parity and seasonal effects were influenced the growth traits of local progenies the superiority of sire was enhanced the growth traits in crossbred progenies. Therefore planned crossbreeding programme between indigenous and Mediterranean buffaloes has a bright prospect for meat production sector in Bangladesh.

Acknowledgements

The research was partially supported by the Private Sector Investment Programme (PSI) of Netherlands entitled "Cattle and Buffalo Improvement in Bangladesh (PSI11/BD/23)". In addition, the authors would like to thank higher management (T.M. Awal and A.A. Mintoo) and all other staffs of LTLL associated with this research facilitation. Special thanks will go for Dr. W. Bruce Currie (Emeritus Professor, Cornell University, USA) for positive criticisms and suggestions in the development of this manuscript.

References

Afzal M, Anwar M, Mirza MA, Andrabi SMH (2009). Comparison of growth rate of male buffalo calves under open grazing and stall feeding system. Pakistan Journal of Nutrition 8: 187-188.

Agudelo-Gómez D, Hurtado-Lugo N, Cerón-Muñoz MF (2009). Growth curves and genetic parameters in Colombian Buffaloes (*Bubalus bubalis Artiodactyla, Bovidae*). Revista Colombiana de Ciencias Pecuarias 22:178-188.

Akhtar P, Kalsoom U, Ali S, Yaqoob M, Javed K, Babar ME, Mustafa MI, Sultan JI (2012). Genetic and phenotypic parameters for growth traits of Nili-Ravi buffalo heifers in Pakistan. Journal of Animal and Plant Sciences 22: 347-352.

Alves, T. C. and Franzolin, R. 2015. Growth curve of buffalo grazing on a grass pasture. Revista Brasileira de Zootecnia 44: 321-326.

Angulo R, Agudelo-Gómez D, Cerón-Muñoz MF, Jaramillo-Botero S (2006). Genetic parameters in buffalo calves fed at full milk in beef production system in middle Magdalena region of Colombia. Livestock Research for Rural Development 18: 180.

Campêlo JEG, Lopes PS, Torres RDA, Silva LOCD, Euclydes RF, Araújo CVD, Pereira CS (2004). Maternal effects on the genetic evaluation of Tabapuã beef cattle. Genetics and Molecular Biology 27: 517-521.

DLS (2018). Department of Livestock Services. Livestock economy at a glance. http://dls.portal.gov.bd/sites/default/files/files/dls.portal.gov.bd/page/ee5f4621_fa3a_40ac_8bd9_898fb8ee4700/Livestock%20Economy%20at%20a%20glance%20%20%282017-2018%29.pdf. Accessed on 18th February, 2021.

Faruque MO (2003). Buffalo production system in Bangladesh. In the proceedings of the 4th Asian Buffalo Congress, New Delhi, India, 31-35.

Giordano G, Guarini P, Ferrari P, Biondi-Zoccai G, Schiavone B, Giordano A (2010). Beneficial impact on cardiovascular risk profile of water buffalo meat consumption. European Journal of Clinical Nutrition 64: 1000-1006.

Pandya GM, Joshi CG, Rank DN, Kharadi VB, Bramkshtri BP, Vataliya PH, Solanki JV (2015). Genetic analysis of body weight traits of Surtibuffalo. Buffalo Bulletin 34: 189-195.

Rodas-Gonzalez A, Huerta-Leidens N, Vidal A, Rodriguez RY, Colina O (2001). Rendimientocarnicero de búfalos vs. vacunosacebuadosproducidos a sabanas y sacrificadosserialmente a cuatroedadescontemporáneas. In the proceedings of the 5th World Buffalo Congress, Maracaibo, Venezuela, 65-69.

Shahin KA, Abdallah OY, Fooda TA, Mourad K (2010). Selection indexes for genetic improvement of yearling weight in Egyptian buffaloes. Archiv fur Tierzucht 53: 436-446.

Zaba MY, Clevañer F (2001). Cría de búfalos en Argentina. In the proceedings of the 6th World Buffalo Congress, Maracaibo, Venezuela, 705-717.