Performance of river buffaloes (*Bubalus bubalis*) from Buffalypso breed in feeding systems based on grazing: fifteen years of researches in the Instituto de Ciencia Animal

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The progress of researches carried out in the Instituto de Ciencia Animal were showed out, they were about productive behavior, feeding behavior, milk and carcass composition, as well as the characterization of lactation and growth curves of buffaloes from Buffalypso breed in feeding grazing systems. Values of milk production per lactation of, approximately, 800kg as average were informed. The equation that was fitted to lactation curve $Yt = 1.86 + 0.03\ t + 0.00003\ t^2 + 1.13\ \ln t$, where t is the time in lactation days, showed maximum production values of 4.87 $l.buffalo^{-1}.day^{-1}$in the interval between 31 and 40 days. In the first 100 d, more than the half and at 200d more than 91% of the total milk production were obtained. The lactation persistence was above 4kg up to 120 d, while correlations between milk production and buffaloes post-parturition weight were not observed. The buffaloes liveweight gain showed 1.6 times higher values in comparison with cattle, and the fattening time was significantly decreased in Buffalypso animals, although they dedicated less time to grass intake, and use it more efficiently. The equations that are adjusted to the growth curve are 4.92 +18.43 (± 0.21) age, where: 3 < age (month) < 24 in males and 546.34/ (1+exp (-0.13 (± 0.003) age + 2.28 (± 0.039), where: 0 < age (month) < 43 in females. Buffaloes showed carcass yield (50.0 to 50.2%) and meat (61.6 to 62.2%) lower to those observed in cattle, but higher in meat production per time and surface unit, as consequence of the best productive behavior. It is discuss about the elements that influence in the behavior and it is suggested to carry out studies with the new crossbreeding of this specie.

Key words: *buffaloes, behavior, lactation curve, growth curve*

INTRODUCTION

The introduction of buffalo specie in Cuba is still recently. For their economical value, to design feeding and management systems that were in agreement with this specie, it is of great importance knowing the productive behavior of these animals, their feeding behavior and its products composition.

In the tropic, buffaloes behavior is the result of feeding system conditions based on grasses. The low dry matter yield, bad quality, seasonal distribution of grasses and their inefficient use, due to the inappropriate management (FAO 2001) influence negatively on the productive results.

In the international sphere, studies about buffaloes behavior show higher values to those informed in researches carried out with cattle submitted to feeding systems in which prevails, in their botanical composition, natural grasses with moderated animal stocking rate. The lactation curve and liveweight changes and body size that buffaloes showed during their life, has not been studied enough (Borguese *et al.* 2013).An appropriate way to describe this performance is the use of mathematical models(Kratochvílová *et al.* 2002).

In fattening cattle, carcass indicators and their components can be affected by management and feeding systems, speed of animals growing, liveweight and slaughter age, as well as breed and sexual condition, among other factors (Avilez 2006 and Uriyapongson 2013).As it been verified, it seems to be that these conditions also influences on the carcass indicators in buffaloes.

The objective of this research is to show the results of the researches carried out in the Instituto de Ciencia Animal de la República de Cuba in 2000-2014, so it can offer a behavior characterization, milk composition, carcass and Buffalypso buffaloes meat in feeding systems based on grazing, with animal load adjusted to these conditions.

REPRODUCTIVE BEHAVIOR

For the study of the unproductive behavior, the data of all female Buffalypso buffaloes of a dairy from the Instituto de Ciencia Animal in the period of 1999-2007 are shown and covers the first eight lactation. The number of female buffaloes with more than eight parturitions decreased in this period, as consequence of the incorporation of F1 animals (Buffalypso x Mediterranean) in the dairy showing another performance, that is not the purpose of this research.

To determined female buffaloes gestation, a rectal diagnostic to the whole mass was carried out. In table 1are showed the female buffaloes reproductive indicators in the evaluated years. Gestation level was excellent, if it is considered that in different years all female buffaloes were gestated, except on 1999, year in which the informed level was not the best (96.7 %) regarding the rest.

Table 1. Reproductive indicators of a female river buffaloes herd

Indicators	1999	2000	2001	2002	2003	2004	2005	2006
Total female buffaloes	30	28	27	39	46	39	28	30
Gestating female buffaloes	29	28	27	39	46	39	28	30
Gestation, %	96.7	100	100	100	100	100	100	100
Births	28	27	26	39	46	37	28	30
Birthrate , %	93.3	96.4	96.3	100	100	94.9	100	100
PPP, d	-	381	365	372	375	380	369	368
PGP, d	-	61	45	52	55	60	49	48

PPP: parturition-parturition period; PGP: parturition-gestation period

In spite of having a prolonged gestation, approximately 315d, the parturition-gestation and parturition- parturition periods allowed to get an annual calf. Although high birthrate levels were reached, in the evaluated period five abortions and died calves in the years 1999, 2000, 2001and 2004 were showed. Nevertheless, with these indicators it can achieve a very encouraging rhythm of the mass growing, aspect of interest if the specie perspectives in cattle development are considered.

PRODUCTIVE PERFORMANCE

The studies of (Buffalypso) buffaloes productive performance in grazing feeding systems show that behaves as double purpose animals, with milk production in restricted suckling next to 800kg per lactation and liveweight gain during growth similar to cattle dedicated to meat production in Cuba, in similar management and feeding conditions, indicator that can be higher in bubaline specie, when animals are only feeding with grass (Fundora *et al.* 2003).

PRODUCTION AND MILK QUALITY

The Buffalypso female buffaloes milk production in feeding system base on grasses, supplemented or not, with stocking rates between 0.8 and 1.2 UGM ha^{-1}, although lower to those of other breeds dedicated to this purpose, show annual production potential next to 800 kg female $buffalo^{-1}$, value that varies according to genetic and environmental factors.

When the genetic selection was not assisted in the dairy of the female buffaloes of this breed, productions of 743 kg, in lactations of 202 were achieved (Mitat 2011). However, the selection of female buffaloes daughters with higher productions, improved these indicators. In the herd from the Instituto de Ciencia Animal de Cuba, the productions were increased each year by the replace effect, approximately, 15% of female buffaloes with worsted productions by the offspring of that which were more efficient.

Although other management factors can influence, the results of table 2 shows that up to the fourth lactation milk production was increased, when incorporating offspring of the best female buffaloes. Later to the eighth lactation, the increase of these indicators continued, but it also influenced, the incorporation of female buffaloes of higher dairy potential breeds. The production decrease in the seventh lactation was due to changes in management, to stabling the animals in the dry season.

The results of the last lactation productions (table 2) are similar to the informed by Scanonne (2006) in selected female buffaloes herds in Venezuela, and higher to those referred to Fraga *et al.* (2007) in a herd of a Cattle Enterprise in Cuba with low attention to

Table 2. Milk production of female Buffalypso buffaloes

Indicators	Lactation								SE ± Sign
	1	2	3	4	5	6	7	8	
Total production, kg	821^{ab}	754^{a}	929^{ab}	850^{ab}	917^{ab}	924^{ab}	754^{a}	988^{b}	64.5 **
Duration of lactation, d	229	220	229	196	212	226	207	241	13.4
Daily average production, kg	3.63^{abc}	3.42^{a}	3.97^{bcd}	4.35^{d}	4.29^{d}	4.11^{cd}	3.59^{ab}	4.10^{cd}	0.17 ***

$^{a, b, c, d}$Means per line with different letters in the superindex differ at $P < 0.05$ (Duncan 1955)

** $P < 0.01$, *** $P < 0.001$

the selection, aspect that reaffirms the importance of genetic selection.

The lactation curve that characterized the female Buffalypso buffaloes milk production of the herd was adjusted by means of the quadratic logarithmic model (figure1).In the equation $Yt = 1.86 + 0.03\ t + 0.00003\ t^2 + 1.13\ \ln t$, that is adjusted to the curve, t represents the time in days, and showed higher values of 4.87 L daily per female buffalo, between 31 and 40 lactation days, These results are similar to the informed by Borguese *et al.* (2013).

suggest that the correlations between milk production and post-parturition weigh of female buffaloes were not significant.

To evaluate in a comparative way milk composition, Fundora *et al.* (2001) carried out a study in female Buffalypso buffaloes and Holstein x Zebu cows (15/16 x 1/16), both fed with star grass (*Cynodon nlenfluensis*). The research showed (table 3) that fat levels duplicated those verified in cows, while total solids and milk protein values were 1.38 times higher in female buffaloes milk. It was considered that in order to obtain 1 kg of milk

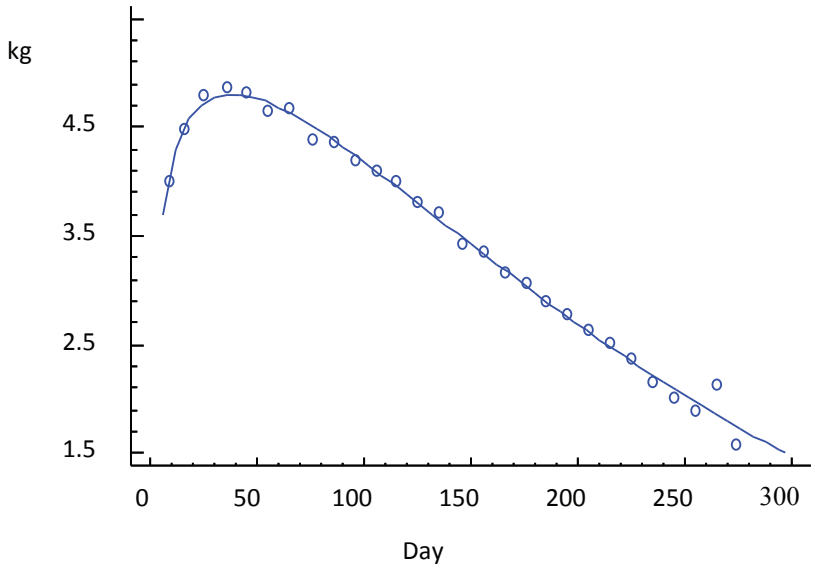

Figure 1. Lactation curve of female river buffaloes (Buffalypso)

The most important results of these studies in feeding systems based on grasses and restricted suckling, related with milk production and lactation curve, suggest that in the first 100 lactation days is obtained more than a half of the total milk production, and it is not necessary to longer the lactation by a higher period to 200d, because in this time more than 91% of total production is achieved. They also show that the higher milk production value was 4.87 kg, and it was obtained in the 30 to 40 d range, as average. These results show that lactation persistence was above of 4 kg until 120d.From 180d, production decrease, was lower to 3 kg daily. The productive behavior of the mentioned herd was above that pointed out by CENCOP (2011) for the national herd in the different lactation periods. The studies

corrected to 4% fat, cows should produce 1.2kg of milk, amount reached with 0.55 kg of female buffaloes milk, what suggested to be used in the elaboration of dairy products, with the consequence benefit for dairy industry.

Certain characteristics that facilitate the productive process also prevail: the highest size of the fat globules of female buffaloes milk which favors churning to produce butter (Ganguli 1998); also, higher percentage of coagulation influence positively in quality (García 1993) and the higher size of the caseine micelle, that reduce protein looses during the industrial process (Ganguli 1992).

Fundora *et al.* (2001) informed that the pH of cow milk was stable, with values approximately 6.6 after four hours, but was reduced to 6.54 six hours after

Table 3. Milk composition of female buffaloes and cow

Indicators	Female buffaloes	Cows	SE ±
Density, kg. L^{-1}	1.037	1.029	0.001***
Fat, %	6.98	3.35	0.25***
Crude protein, %	5.40	3.87	0.12***
Total solids, %	15.55	11.23	0.29***
Non- fat solids, %	8.57	7.88	0.33

*** $P < 0.001$

milking, and it declined to reach 5.2 twenty four hours after milking. However, pH first dropped four hours later in buffaloes milk, that is, ten hours after milking, and continued decreasing to reach 5.53 twenty four hours after milking. Thus, pH declined during the first twenty four hours after milking in 1.4 units in cows and 1.06 in female buffaloes milk (figure2).

On comparing cow and female buffaloes milk stability showed that, in the first ones, the change in reductase was produced at 6.2 h. No change was observed in female buffaloes milk ten hours after milking. This could be associated to that found by García (1993) regarding the lower bacterial growth in female buffaloes milk, which is related to its high lecithin content and to a glycoprotein which inhibits the development of undesirable bacteria that require iron.

These results, from the practical point of view, constitutes an important element win the management of fresh female buffaloes milk for human consumption or when milk is processed outside the dairy unit, where collection is more complicated, due to female buffaloes are generally located in areas of difficult access.

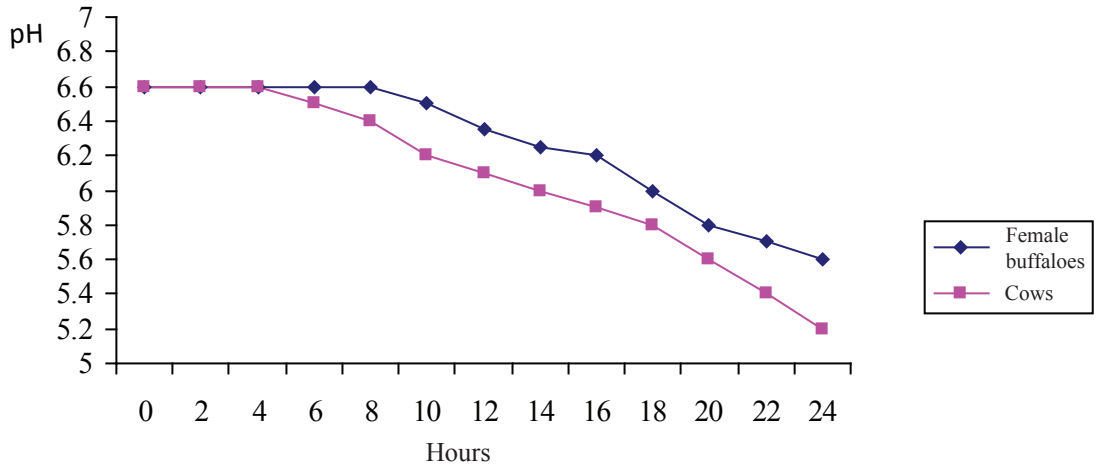

Figure 2. pH variation during 24h after milking

MEAT PRODUCTION

The results of experiments based on the fattening of grazing buffaloes, in which specific studies on buffaloes Buffalypso are included, and others in which this breed is compared with Carabao and its crossings, that are used for meat production in Cuba. Comparisons with cattle are also exposed, with the objective to know the Buffalypso potentialities for meat production.

In a study to evaluate the behavior and carcass composition of Buffalypso buffaloes, fed with star grass, natural grasses and native legumes (Fundora *et al.* 2004), the animals attained the slaughter liveweight at 23.1 months of age, with an average daily gain rate higher than 700g (table 4).The behavior was good, considering the poor botanical composition of pastures, with approximately 38% of low consumable plants. Earlier age at slaughter and higher liveweight than those for cattle in similar systems were obtained, according to the results observed by Valdés and Senra (1999) and Castillo *et al.* (2000).

Table 4. Performance of Buffalypso buffaloes in the growing-fattening stage under grazing, carcass yield and its components

Indicators	Average value	SD
Initial weight, kg	130.5	12.5
Final weight, kg	474.0	18.9
Daily liveweight gain, g	706.3	73.7
Age at slaughter, months	23.1	1.2
Carcass yield, %	48.3	1.2
Meat	69.1	2.2
Bones	20.3	0.6
Fat	9.0	1.2

The carcass yield is relatively low, in which the skin weight influenced because it has a greater thickness than the cattle, and also the head weight because it has a higher development.

In a comparison of the productive performance and the behavior of Buffalypso buffaloes and commercial zebu of 261and 294 kg of liveweight respectively, that grazed together and intake grasses composed by star (*Cynodon nlenfluensis*), mixture of natural grasses mixture and razor grass (*Paspalum virgatum*) and 60g of mineral salts daily per animal per day, higher liveweight gain were verified in buffaloes during 287 d that the experiment lasted (table 5), with rate 1.6 times higher in comparison with cattle.

The comparative study of the intensity of mastication and rumination of buffaloes and cattle indicated that, in spite of the number of mastication for the forage ingestion and the number of movements per each ruminated cud were similar, the number of regurgitated cuds and ruminations movements per unit of time was lower than in buffaloes. From the proportion of circadian time devoted to ingestion, dry matter intake and the number of mastications movements per unit of time, was estimated that buffaloes and cattle performed 11 886 and 19 210 mastications movements per day and 2406 and 3074 movements kg^{-1} of dry matter ingested, respectively. This represented in buffaloes 61.9 and 78.2 % of

Table 5. Performance[1] and behavior of buffaloes and cattle (Fundora *et al.* 2003)

Indicators	Specie		SE±
	Buffaloes	Cattle	
Final liveweight, kg	440	378	13 **
Daily liveweight gain, g	567	353	28 ***
Intake, % of the total time	43.9 (48.0)	47.5 (54.3)	0.8 *
Rumination, % of the total time	28.3 (22.4)	26.1 (19.4)	1.1

[1]A covariance adjustment was performed to the initial liveweights
( ) Values between parenthesis represent original data
* P < 0.05, ** P < 0.01, *** P < 0.001

The results of table 5 shows that buffaloes in spite of gaining more liveweight they dedicated less time to grasses intake, because they used this fibrous food more efficiently than the cattle, due to the anatomical and physiological characteristics that supposed higher food intake per unit of time according to that informed by Carrero (1998).However, the opposite was demonstrated in Fundora *et al.* (2007) later study. Buffaloes dedicated less time to grasses and dry matter intake related to the liveweight and metabolic weight. The intake speed was lower in this specie too. (table 6).

movements regarding to those of cattle. On the other hand, when considering the circadian time devoted to rumination and the number of jaw movements performed for this activity, the buffaloes made 26 032 movements daily and cattle, 29 031, this represented11.5 % lower than the former.

The decrease of jaw movements per unit of time in ingestion and rumination could be one of the causes that contribute to the best productive performance of the buffaloes regarding to cattle, in similar feeding and management conditions. This was also observed by Rodas *et al.* (2001) and could be due to lower energy

Table 6. Comparison of intake speed and intensity of mastication and rumination in buffaloes and cattle

Indicators	Buffaloes	Cattle	SE± Sig
Speed of forage intake in HB (kg. h^{-1})	2.0	3.1	0.2 ***
	6.02	6.31	
Number of mastications for the forage intake. min^{-1}	(36.85)	(40.55)	NS
	0.1120	0.0986	
SE±	6.40	7.11	
Number of ruminations movements. min^{-1}	(41.18)	(51.04)	
	0.0667	0.0659	***
SE±	6.42	6.33	
Number of movements /ruminations cuds. min^{-1}	(41.23)	(40.31)	NS
	0.0360	0.0356	
SE±	1.00	1.12	
Number of regurgitated cuds. min^{-1}	(1.00)	(1.27)	
SE±	0.0094	0.0093	***

( ) Values between parenthesis represent original data
*** P < 0.001

expenditure in these activities.

In a second experiment, Fundora *et al.* (2014) compared the behavior and carcass composition of the two buffloes breed and two of cattle, used in Cuba fattening. A total of 20 Buffalypso buffaloes same quantity of Carabao or crossbreed, 20 crossbreed cattle Siboney de Cuba and 20 Commertial Zebu were used, with initial liveweights of 170, 184, 201 and 209 kg, respectively. The animals were located together, in grazing of 77 ha, divided in four paddocks during a year.

Although the initial liveweight was lower in the Buffalypso, the daily liveweight gains (DLW) were higher in this breed in the total fattening stage, regarding to the obtained in Siboney breed cattle and in the rest of evaluated genotypes. That is why; fattening time was significantly decreased in Buffalypso animals. The worst behavior in both traits show it the cattle of both breeds (table 7).This result is important, if it is considered that, in 2002, Cuba has 100 dairies of females (Buffalypso) buffaloes approximately, that were substantially increased up to 249 units in 2010 (García 2011). As consequence, the quantity of males that these annually produced, it significantly increased the meat contribution to the industry.

Buffaloes, in comparison with cattle, showed lower yield of carcass and meat as carcass percentage. The first one is related with the skin weight that was higher in buffaloes. Similar results referred Huerta-Leindez (1999) and Angulo (2005), and it is the most influence element, joined to the head and belly, in carcass yield (Mendes- Jorge and de Lima 2011).

The obtained results suggest that buffaloes use efficiently the grass, as consequence of the appropriate fibers digestion, as Wanapat and Chanthakhoun (2009) showed. It is probable that the higher behavior of Buffalypso regarding to Carabao is due to the first one is more docile, what is associated to rearing system in dairies, while the Carabao rearing system is in raising pen, where the relation with the man is poor. In these lasts a nervous behavior was observed during its management.

The yield in buffaloes meat could be affected by the higher percentage of subcutaneous fat in their carcass. This matter could be due to low energy losses of buffaloes in mastication and rumination activities, as it was showed before.

Nevertheless, the liveweight (251, 218, 196 and 202 kg. ha^{-1}) and meat (72.0, 62.0, 60.1 and 53.6 kg. ha^{-1}) production in Buffalypso, Carabao, Zebu and Syboney, respectively, suggest more efficiency for meat production in Buffalypso, as consequence of the higher growth rhythm of this breed.

The buffaloes of Buffalypso breed showed higher weight of the later quarters and its proportion regarding to carcass, where the most valuable cuts are located, according to Mendes and de Lima (2012). A similar result was informed by Mendes *et al.* (1997 a,b) and Mendes and Fontes (1997) in cattle and in some buffaloes breeds, while in Carabao the opposite happened. Nevertheless, the proportion of first quality

Table 7. Carcass performance , yield and composition of buffaloes and cattle breeds in Cuba

Indicators	Breeds				Sign
	Siboney	Cebú	Buffalypso	Carabao	
Final liveweight, kg	34.5[a] (395.2)	39.6[ab] (397.7)	53.5[b] (412.0)	34.5[a] (394.2)	*
SD	18.8	28.0	26.9	19.3	
Daily liveweight gain, g	23.6[a] (427.6)	27.6[a] (438.3)	65.6[c] (623.7)	45.4[b] (506.4)	***
SD	75.9	95.4	81.2	67.0	
Fattening time, d	58.7[c] (460.1)	43.7[b] (437.7)	21.7[a] (390.5)	38.0[b] (417.3)	***
SD	26.2	47.6	39.9	49.9	
Carcass yield, %	51.2[b]	51.09[b]	50.04[a]	50.21[a]	* SE ±0.34
Skin, % of empty liveweight	11.0[a] (9.2) SD=0.4	30.0[b] (10.3) SD=0.4	57.3[c] (12.4) SD=0.7	63.8[c] (12.8) SD=0.6	***
Meat, %	60.3b (65.4) SD=0.7	55.3[b] (65.0) SD=2.1	25.8[a] (62.2) SD=1.6	20.6[a] (61.6) SD=1.3	***
Bones, %	15.8[a] (22.9) SD=0.4	42.4[b] (24.0) SD=0.7	45.2[bc] (24.5) SD=1.4	58.7[c] (25.8) SD=2.1	***
Fat, %	26.2[a] (9.0) SD=0.5	25.6[a] (8.8) SD=1.3	52.6b (10.2) SD=1.0	57.6[b] (10.5) SD=0.9	***

[a, b, c, d] Means per row with different letters in the superindex differ at $P < 0.05$ (Duncan 1955)

( ) Values between parenthesis represent original data

* $P < 0.05$ *** $P < 0.001$

meat regarding the carcass was similar in animals of both breeds. Similar proportions of first and second quality meat were also observed, regarding the total meat in both breeds (figure 3).

The highest development of forequarter respect hindquarter Carabao buffaloes, may be caused by their frequent use as a labor tool in many countries, which did not happen with animals of breeds that originated Buffalypso breed. These last have been dedicated mostly to milk production.

Although Buffalipso breed showed higher development, the similarity in the first quality meat proportion regarding the carcass in animals of both breeds, although this meat type is in the later quarters, as it was showed before, could be related with the particulars characteristics of the different cuts of this area in each breed, aspect that should be study more exactly.

The percentages of special cuts in the first quality meat are show in table 8.The knuckle, rump and eye round did not significantly differ between breeds, while Carabao buffalo produced higher inside round and tenderloin proportions and less of shortloin, in comparison with Buffalypso. However, in absolute terms, Buffalyso buffaloes produced 6kg more of total meat (3.9 kg of second quality meat and 2.1 kg of first quality meat).The tenderloin is excepted, that had similar weight in both breeds. The remainder cuts of the first quality meat weighed more in the animals of Buffalypso breed, as consequence of the higher liveweight reached by these ones (Fundora *et al.* 2014) and of their carcass to the slaughther.

The meat bromatological composition of the Buffalypso buffaloes is show in table 9.The average values of dry matter and nutrients are similar to the informed by other authors (Mendes and Andrighetto 2005 and Andrighetto *et al.* 2007).The higher protein level in the meat samples could contributed to the veined or marbled color, if the intermuscular fat level is adequate, in accordance with the informations carried out by Reback (2011).

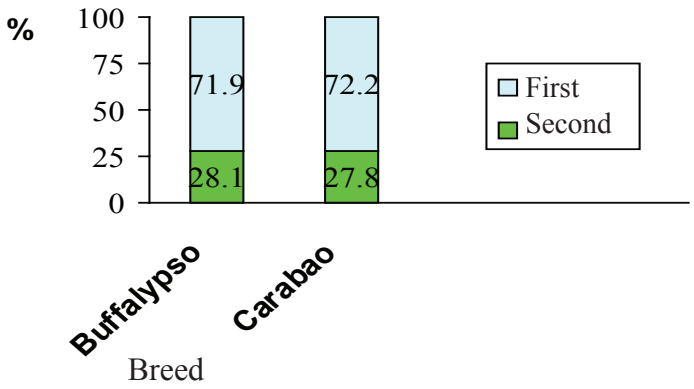

Figure 3. Proportion according to total meat quality

Table 8. Proportions of special cuts in the first quality meat, %

Special cuts	Breed		SE± Sign.
	Buffalypso	Carabao	
Knuckle	30.2	29.7	0.2
Inside round	22.3	23.1	0.2 *
Rump	15.4	15.4	0.1
Shortloin	15.0	14.2	0.2 *
Eye round	10.2	10.1	0.1
Terderloin	6.9	7.5	0.1 **

*P < 0.05 **P < 0.01

Table 9. Bromatological composition of Buffalypso buffaloes meat

Indicators, %	Mean	Maximum	Minimum	SD
Dry matter	26.9	31.9	22.0	3.2
Crude protein	29.4	30.0	28.7	0.5
Fat	1.1	1.6	0.6	0.3
Calcium	1.3	1.7	1.1	0.5
Phosphorus	0.6	0.7	0.5	0.1

The texture and water retention are two important elements in the meat. As table 10 showed, meat can be classify as tender, since texture values are relatively low, while water retention capacity is appropriated. In bovine, Sañudo *et al.* (2004), observed similar results in low age animals, what suggests that the slaughtered buffaloes in this study, with approximately two years of age, produced tender meats, to what can contribute the specie characteristics, related with their longevity that overcomes to the bovine specie. These results, related with the high protein level and texture (tables 4 and 5), joined to the informed by other authors, that suggest a meat with nutraceutical effects (Zicarelli 2012), show the necessity to continue studies on the carcass and buffaloes meat, in this and in other feeding and management systems, to get a competitive meat going to the market and persons that need to consume proteins coming from healthy protein sources.

Table 10. Texture and other indicators of Buffalypso buffaloes meat quality

Indicators	Mean	Maximum	Minimum	SD
pH	5.9	6.4	5.0	0.5
Temperature, ºC	26.0	27.3	24.4	0.8
Capacity of water retention	0.2	0.3	0.2	0.1
Texture, Nw	171.5	240.1	83.3	51.5

GROWTH CURVE

For the study of Buffalypso buffaloes growth curve, data of the liveweight of the males and females, born from 30 primiparous female buffaloes and the two fallowing calvings were used. The offspring feeding system consisted on the intake of the whole milk in free suckling up to 10d of age, and restricted suckling and rotational grazing from 11d up to the weaning. Later on, the animals were separated by sex and were allocated in a rotational grazing system with a mixture of natural grasses and star grass, up to the slaughter of the males and the incorporation to reproduction of the females.

Linear and logistic models were used to select that of best fit. The equation y = a+ bx was used for the linear model and y = a / (1 + exp â (- ãx) for the logistic, where a and exp ã represent the slope of the curve, respectively. The initial value of the parameters was calculated through Microsoft Excell on Window XP. The models were adjusted through the statistical SPSS on Windows. V10.1 (Visauta 1998).

Due to the liveweight of the males was obtained from three months of age up to 500 kg, maximum weight of slaughter, the liveweight curves are in correspondence with the performance of this indicator up to this weight.

In table 11 are showed the results of the linear models adjusted for each offspring and the general model in the males. All the adjustments were significant, with values of R^2 higher to 93%.The values of regression coefficients are the monthly increase of liveweight of each offspring and the general.

The monthly liveweight performance of the first offspring was higher. This result was associated to the fact that the animals of this offspring had better quality pastures, which were deteriorated later as the animal stocking rate was increased. In the second and third were almost the same. These coefficients of regression may be interpreted as the monthly increase of liveweight, that is, 19.46 kg/month in the first offspring, 17.7 kg in the second and 17.1 kg in the third. The general regression was estimated, due to the similarity of the obtained coefficients for each offspring. This table shows, the regression obtained, which had slope of 18.4 kg/month, corresponding to the monthly liveweight gain with higher variance, due to the pool of the three previous variances.

According to these results, the equation that expresses the performance of the monthly liveweight gain in kg of the males Buffalypso buffaloes is the following:

LW males (kg) = 4.92 +18.43 (± 0.21) age, where: 3 < age (month) < 24

In the analysis of the females there was a liveweight performance that was stabilized after 25 months of age, thus both models were tested to analyze the best fit from the statistical point of view. This stability from

Table 11. Regression fitted for the liveweight of the males of the different offsprings (Fundora *et al.* 2006)

Offsprings	R^2	a	b	SEb±	MSE	Sign
1	0.97	11.12	19.46	0.30	596.82	P<0.001
2	0.95	6.92	17.70	0.32	824.48	P<0.001
3	0.93	6.93	17.09	0.35	803.97	P<0.001
General	0.94	4.92	18.43	0.21	4660.19	P<0.001

25 months of age is of importance from the practical point of view, because it indicates, from that, the animals may be incorporated to reproduction because they have almost grown completely

Both models had the same determination coefficients. However, the variance was lower in the logistic model, ensuring better goodness of fit (table 12).

The convenience of using other models such as the estocastic, by the proximity of the observed values and the estimates in the grow curve were showed by Torres and Sampaio (2005). However, the results of the informed adjustments in this study are adequate for the interpretation of the grow curve of the females Buffalypso, but it is recommended to develop studies where this mathematical model is evaluated.

Figure 4 represents the growth model of the females, obtained from the liveweight curve (Fundora *et al.* 2006). It can observed the maximum growth between 21 and 26 months, whereas before 5, and since 40 months, is very low, with values lower than 7 kg monthly. This is logical, considering that before the 5 months calves were feed only with an amount of restricted milk, and grasses of regular to bad quality, period in which have not completely developed their digestive system, while females buffaloes have been attained most of the growth since that age.

The model of determination of the growth curve of females Buffalypso is determined by the equation: -ab exp (-bt+ c)/1+ 2 exp (-bt+ c) + exp (-bt+ c) 2.

According to these result, the equation expressing the performance of the monthly liveweight gain in kg of the females Buffalypso buffaloes up to 43 months is:

LWG, kg (females) = 546.34/ (1+exp (-0.13 (± 0.003) age + 2.28 (± 0.039), where 0 < age (months) < 43

Table 12. Models fitted for females liveweight (Fundora *et al.* 2006)

Model	R^2	a	b	c	MSE	Sign
Linear	0.91	42.19	12.71	-	2383.48	P<0.001
SE±			0.121			
Logistic	0.94	546.34	0.13	2.28	1748.87	P<0.001
SE±			0.003	0.039		

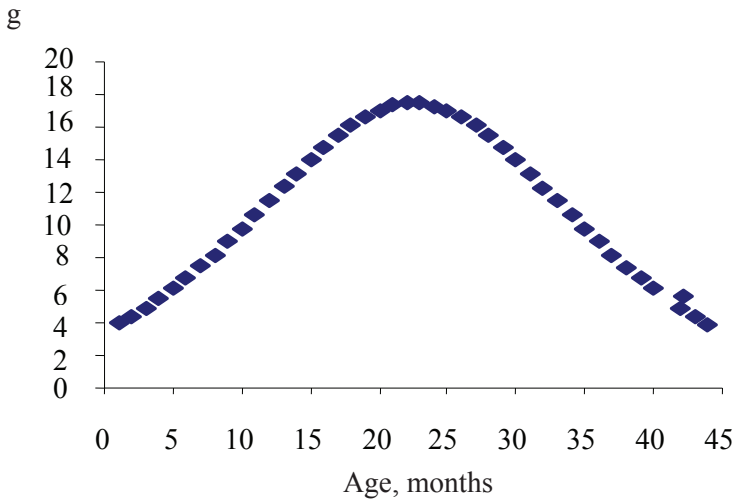

Figure 4. Growth curve of river buffaloes

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that in feeding system based on grazing, with natural grasses, the females Buffalypso buffaloes with restricted suckling have average potential of 800 kg.lactation^{-1},but when genetic selection is applied the productions increases. The duration of lactations, although with individual variability, they suggested that they should not extended for a period higher to 200 d.

The characterization of the lactation curve of females from this breed show a maximum of production between the 31 and 40 d of lactation and their persistence significantly decreased from 120d.

Milk composition is similar to that informed in other breeds and show higher stability in comparison with cow milk.

The males productive behavior in the fattening stage is higher to that showed by cattle, in same management and feeding conditions in systems based on grass, prevalence natural grasses, and higher daily liveweight

gains and liveweight gains per surface unit, indicators that reduce the lowers yields of their carcass and the animals final performance. These results are associated to the best use of the vegetable fiber by the many physiological factors effect.

The growth curve of the female Buffalypso buffaloes showed higher weight gains between 21 and 26 months, aspect that should be considered to select the best moment to incorporate the female young buffaloes.

It is recommended to continue studies about this species behavior in the new genotypes that are developing in the country and to establish new feeding and management strategies, according with the results of the researches reviewing here.

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