Buffalo Newsletter

Number 39 January 2023

BULLETIN OF THE FAO-ESCORENA INTER-REGIONAL COOPERATIVE RESEARCH NETWORK ON BUFFALO AND OF THE INTERNATIONAL BUFFALO FEDERATION – INCLUDES SHORT COMMUNICATIONS, RESEARCH PAPERS, TECHNICAL NOTES, ONGOING RESEARCHES

Inside this Issues

The World Buffalo Congress which should have taken place in October 2022 in Wuhan, China, has been cancelled due to the pandemic. There has been an election and it was chosen Venezuela and President Nicola Fabbozzo to host the 13th World Buffalo Congress, to be held in Caracas on November 13-15, 2023 (pg 43)

On 15-18 November 2022, the 10Th Symposium of America and Europe was held in Asunción, Paraguay. You can find a wide description of the activities on pg 36.

In the scientific focus section, we are presenting various papers on nutrition for meat production (pg 3), meat characteristics (pg 8), buffaloes in America (pg 16), in Mexico (pg 21), in Cuba (pg 25) and the special issue on Recent developments in buffalo reproduction published on the journal *Animal* (pg 33).

Unfortunately, Dr Reggeti, an IBF member from Venezuela, passed away and we unknowledge his contribution to buffalo development in this number.

The IBF Secretariat worked to maintain connections and support to associates. Other requests to become members were examined, reaching 147 IBF associates, representing 35 countries. The list is enclosed, as usual, at the end of this Newsletter

The Editorial Committee

Buffalo Newsletter - Number 39 – January 2023

Editor: **Antonio Borghese**
antonio.borghese@email.it

Editorial Committee
Vittoria L. Barile, Antonella Chiariotti
CREA, via Salaria 31, 00015 Monterotondo (Roma) – Italy

IBF Secretariat
Antonio Borghese, Vittoria L. Barile, Antonella Chiariotti,
Carlo Boselli, Federico Infascelli, Anna Chiacchierini

Network Co-ordination Centre, to which correspondence is to be sent:
internationalbuffalofed@gmail.com
IBF, via Salaria 31, 00015 Monterotondo (Roma) – Italy

SCIENTIFIC FOCUS
BUFFALO FEEDING FOR MEAT PRODUCTION

Federico Infascelli

Department of Veterinary Medicine and Animal Production
University of Naples Federico II

In Italy, the Buffalo (Bubalus bubalis) is mainly bred for milk production to produce Mozzarella, a fresh cheese highly appreciated also in international markets, even if an increasing interest in its meat has been registered in recent years. Differently to the past when buffalo meat was poor appreciated because only low-quality meat from females with productive or reproductive problems was marketed, nowadays it has been demonstrated that using adequate feeding systems, favourable nutritional characteristics can be achieved (Infascelli et al., 2004).

The success of buffalo breeding depends on good management and balanced feeding of calves, which ensure the optimum growth rate so they can attain early maturity weight (Infascelli and Tudisco, 2013). Aside from its nutritive value and laxative action allowing the evacuation from the intestine of faeces and meconium, colostrum intake in newborn ruminants is important because it is the main way to obtain maternal antibodies. Indeed, a significant amount of immunoglobulins reach the blood of calves thanks to the permeability of the epithelial cells of the small intestine and the lymphatic system. Calves start suckling 2-3 hours after birth, and the absorption of immunoglobulins lasts up to 24 hours. This period is critical since many diseases of newborn calves are related to insufficient colostrum intake and/or poor

colostrum quality, which is determined by the content of immunoglobulins. The IgG1 is the best-represented immunoglobulin in the colostrum and its passage from the blood begins four to six weeks before birth, allowing a concentration at first milking 2-10 times more than in the serum of maternal blood. To ensure adequate passive transfer of immunity, neonatal buffalos should receive good quality colostrum divided into 4 to 6 feedings of equal proportions, preferably within 3 to 12 hours after birth. Failure to ingest and/or absorb sufficient colostral IgG, increases the risk of illness and death, until at

least 6 to 7 wks of age, from bacterial septicemia and common neonatal infectious diseases. Colostrum substitutes have had limited success in terms of calf survival rate. Nevertheless, very little has been done to identify feeding supplies able to improve passive immunity in buffalo calves despite newborn mortality being very high in such species, the genus Aloe plant, applied for medicinal practice over thousands of years, could play an interesting role. Indeed, the polysaccharide fractions of Aloe have been reported as potent B cell stimulators in either in vitro or in vivo studies. Infascelli et al. (2010) performed research aimed to explore the influence of supplying the diet of pregnant buffalo cows with *Aloe arborescens* on the colostrum immunoglobulin content. For this purpose 24 buffalo cows, during the last two months of pregnancy, were divided into 2 homogeneous groups fed two iso-energetic and iso-proteic TMR which differed only for the addition, in the experimental group of 50 g/head/day of a product containing *Aloe arborescens*. The colostrum from the experimental group showed a significantly higher IgG concentration (mg/ml 78.5 vs 71.3; $P<0.01$). The authors discussed their results as follows: cell surface polysaccharides, when recognized by pattern recognition receptors (PRRs), are effective stimuli for activating quiescence macrophages and other immune cells. These substances are named polysaccharide biological response modifiers (BRMs). According to the sugar compositions, there are 3 major groups of polysaccharide BRMs: β-1,3-Dglucans, α/β-1,4-mannan and highly branched

polysaccharide of very heterogenous monosaccharide compositions and α/β-1,4-mannan is mainly derived from the yeast cell wall fresh layer of Aloe leaves. In particular, the polysaccharide BRM, PAC-I, purified from Aloe was demonstrated to exhibit potent stimulatory effects on B and T lymphocytes. PAC-I is thus a potent stimulator of murine macrophage. In conclusion, both groups produced good quality *colostrum*: 60 mg/ml within 1h from calving is a threshold for discriminating scarce or sufficient IgG concentration. However, *Aloe arborescens* increase the colostrum's IgG, thus improving passive transfer in newborn calves. Therefore, in the case of dams producing medium or low-quality colostrum, Aloe may increase its immunological properties thus reaching a quality still acceptable to ensure passive transfer in calves.

In the successive phases of calves growth, in formulating milk replacers for buffalo calves it must be taken into account that buffalo milk shows a higher Ca/P ratio (Ca 1.8-2 g/kg; P 1.1 g/kg; ratio 1.73) than dairy cows milk (Ca 1.1-1.2 g/kg; P 0.8 g/kg; ratio 1.33), and that the intake capacity of buffalo calves is lower when compared to a bovine calf (2% vs 2.4- 2.8% of DM/100 kg LW). To allow the same concentration per kg of milk reconstituted at 12-14%, 13-15 g of Ca and 8.5-10 g of P/kg of milk powder DM are required. The Ca/P ratio during suckling, due to vitamin D deficiency in milk, is the only factor which guarantees an optimum absorption of the two minerals. The latter is very important given that buffalo is classified as a precocious species, reaching adult body composition rapidly with very swift completion of skeletal tissue growth. In addition, milk replacers for buffalo calves must be integrated with no more than 5 mg/kg of copper to avoid episodes of intoxication with a high death rate. Tripaldi et al. (2001) compared the performance of three groups of male and female buffalo calves fed acid milk replacers for bovine (group 1, concentration: 12.5%) or buffaloes (group 2, concentration: 18%; group 3, concentration: 22%). The trial was divided into three experimental phases: A: ad libitum administration; B: rationing of milk replacers; C: beginning of hay and concentrate intake. The intake of milk replacers was significantly higher for group 1 decreasing as its concentration increased; the intake of milk powder was the lowest for group 1 and the highest for group 2 (0.75, 1.09, 1.01 kg, for groups 1, 2 and 3 respectively). The daily weight gain (DWG) was significantly lower for group 1 during the A and B phases, reaching the values of other groups during the third phase. In any case, considering the whole trial, group 1 showed the worst results. Group 3 had the most favourable even if the differences with group 2 were not significant. The feed conversion index (FCI) during phase A was significantly lower for group 1 (1.86, 1.29 and 1.19, groups 1, 2 and 3, respectively) and also during the whole trial. The milk replacers for buffalo at 22% of concentration showed the best results. Di Lella et al. (1998), in a trial aiming to verify the influence of the feeding programme on the growth dynamics of young buffalo bulls, divided 24 seven-days-old buffalo calves old according to a 2 x 2 factorial design: two weaning ages (63 d vs 84 d); two weaning concentrates (CP 17% vs 14%; starch 37% vs 29.6%, as fed). The calves of groups A and B, weaned at 63 d, received until 42 d 6 l/head/d of acidified milk replacer, in the ratio of 180 g/l of water. Subsequently, the replacer amount was gradually decreased, administering the same volume. The animals of groups C and D received, until 56 d 8 l/head/d of the same milk replacer, but in the ratio of 140 g/l. Also, in this case, leaving the volume unchanged, the replacer was gradually decreased. Roughly chopped alfalfa hay and weaning concentrate were available from the fifth week; corn silage was administered starting from 70 d. After weaning, the animals were fed ad libitum hay and corn silage; the concentrates were administered in the amount of 12 kg/d/group. The weaning age did not influence performance. By contrast, the weaning concentrate strongly affected the growth dynamics in the first 6 months: in this phase, the concentrate with higher protein and starch content had better results. However, in the subsequent period (6–16 months) , improved performance was obtained using concentrates with less favourable characteristics because of compensative growth. These observations suggest that concentrate with higher protein and starch content be administered during the weaning when the calves are destined to be slaughtered at lower weights compared to those reached in

this trial (400 kg); otherwise, it could be opportune to administer the protein-poor concentration contain feeding costs.

More recently, to reduce feeding costs, several farmers are searching for protein sources alternative to soybean in buffalo diet; indeed, a large part of the available soybean is genetically modified thus still determining public concerns due to its health potential risks. Faba bean (*Vicia faba* var. minor) has high nutritional value (CP 25–35% and high lysine content) and is relatively cheap. In addition, grain legume increases the sustainability of crop-livestock systems due to the safeguarding of soil fertility. In such a

contest, the research group of Animal Nutrition of the Department of Veterinary Medicine and Animal Production, University of Napoli Federico II, coordinated by Prof. Infascelli performed a trial aimed to evaluate the influence of a diet containing fava beans on infra Vitam performances and the nutritional characteristics of meat from young buffalo bulls, the latter parameters reported by Calabrò et al. (2014). For the study, sixteen eight days buffalo males, equally divided into two groups (FB, fava bean and SB, soybean) received 6.0 L/head/d of acidified milk replacer (180 g/L of water) until 56 days of age. Successively, to obtain the weaning at 80 days of age the replacer amount was gradually decreased, even administering the same volume. From the 70th day, corn silage was administered, while mixed hay and weaning concentrate was fed from the fifth week. After weaning, the calves received mixed hay and corn silage ad libitum, and concentrate (2.0 kg/d). At 84 days, the calves were placed in an individual box up to the slaughtering weight and fed (2.7% BW) isoprotein (CP: 15.2% DM) and isoenergy (0.91UFV/kg DM) diets, differing in protein source of concentrate: fava bean vs. whole seed soybean. The body weight was monthly measured, the infra *vitam* (height at withers and pelvis, round circumference, length of rump, body length, depth of chest, width of pelvis and chest) as well the post mortem (carcass length, chest depth, leg length, leg width, leg thickness) were detected. No difference between the groups for all these parameters was registered. Thus, fava bean can be used as a protein source alternative to soybean in the diet of young buffalo bulls.

References

Tripaldi C., Failla S., Verna M., Roncoroni C. 2001. Allattamento dei vitelli bufalini: composizione e concentrazione del latte ricostituito. Proc. I Congr. Naz. sull'Allevamento del Bufalo. Ed. Bubalus bubalis 399-403.

Calabrò S., Cutrignelli, M.I., Gonzalez O.J., Chiofalo B., Grossi M., Tudisco R., Panetta C., Infascelli F. 2014. Meat quality of buffalo young bulls fed faba bean as protein source. *Meat Sci*. 96:591–596.

Di Lella T., Cutrignelli M.I., Calabrò S., Infascelli F. 1998. Influenza del piano di alimentazione sulla dinamica di accrescimento di maschi bufalini fino all'età di 16 mesi. *Bubalus bubalis* 2:81-90.

Infascelli F., Gigli S., Campanile G. 2004. Buffalo meat production: Performance infra vitam and quality of meat. *Veterinary Research Communications*, 28:143–148.

Infascelli F., Tudisco R., Mastellone V. et al. 2010. Diet Aloe supplementation in pregnant buffalo cows improves colostrum immunoglobulin content. *Revista Veterinaria* 21. Suppl.1:151–153.

Infascelli F., Tudisco R., Pacelli C., Borghese A. 2013. Nutrition and feeding. In: Buffalo Livestock and Products edited by A. Borghese, CRA, 175-212.

CARCASS CHARACTERISTICS AND QUALITY TRAITS, PRESERVATION TECHNOLOGY AND PROCESSING OF BUFFALO MEAT

Sebastiana Failla, Michela Contò

Council for Agricultural Research and Agricultural Economy Analysis, CREA - Research Centre for Animal Production and Aquaculture, 00015 Monterotondo, Rome, Italy

Introduction

Buffalo meat in the last decade has undergone fluctuations and variations, both in production quantity (T) and in population head. According to *FAO Stat data* (table 1), the world meat buffalo population in 2021 was more than 28,6 instead of 26,0 Mil head in 2011 and buffalo meat production was more than 4,3 versus 3,8 Mil T (respectively for the years 2021 and 2011). India, Pakistan and China are the majority countries for buffalo meat production whilst, in Europe, buffalo distribution is concentrated mainly in Italy.

Table 1. Consistency of buffalo head for meat production and meat production (T) (*FAO Stat data)*.

2021	***Buffalo head***	***% on 2011***	***Meat production T***	***% on 2011***
World	28,601,802	+8.8	4,322,190	+10.0
Asia	27,870,440	+11.2	4,107,874	+15.5
India	11,682,255	+3.3	1,616,853	+3.5
Pakistan	8,111,000	+20.4	1,151,000	+32.7
China	4,526,052	+7.1	658,617	+7.2
Egypt	504,634	-60.3	166,744	-57.9
Americas	115,779	+93.1	26,047	+93.1
Europe	110,949	+47.7	21,524	+49.3
Italy	107,949	+47.6	21,276	+50.0

Global buffalo meat production is growing (Di Stasio et al., 2021) also because buffalo meat products exhibit positive characteristics for human health; in fact, this meat can provide a good amount of essential amino acids, fatty acids, vitamins (particularly B group) and minerals such as Fe (iron), Zn (zinc) and Cu (copper), low cholesterol, high monounsaturated fatty acids (Tamburrano et al., 2019), so representing a feasible substitution of beef.

Buffalo's breeding and management are very different among the countries; hence the milk and meat products vary accordingly (Borghese et al., 2022).

Regarding meat production, numerous studies are carried out to improve knowledge of production systems, slaughtering, marketing, new technologies and organoleptic quality (Juárez et al., 2019).
In Italy, buffaloes are reared for dairy products in particular for *Mozzarella* Cheese which is a DOP product, whilst buffalo meat has a minor spread. However, the improvement of knowledge on meat quality and meat processing of Mediterranean Italian buffaloes is bringing about the consumption trend because buffalo meat could represent a considerable economic and nutritional source (Di Stasio et al., 2021; Calabrò, et al., 2014).

Carcass quality

The principal problems of buffalo meat production, in Italy, are relative to the low yield and an excessive subcutaneous fattening deposition when buffalo is older than 14 months. Nevertheless, some studies pointed out adequate production efficiency and good meat quality of buffalo bulls when compared with some cattle bulls (Juárez et al. 2019).

The first quality parameter for estimating the aptitude for meat production, is the conformation and fatness score of the carcass, according to the SEUROP system. Carcass conformation is influenced by the nutritional and/or energetic diet levels and slaughter age.
Accurate knowledge of the growth rate of carcass cuts and tissues also has economic and commercial significance. Gigli et al., (2001) reported that carcass conformation and fatness scores improved with the animal's age (table 2). Carcass conformation increase from "O" (quite good) to "R" (very good) and the fatness score goes from 1 (lack fat) to 3 from 6 to 18 months of slaughter age.

Table 2 – Carcass conformation and fatness score

in buffalo at different slaughter ages (Gigli et al. 2001)

Age months	**Conformation score**	**Fatness score**
6	O+	1+
10	R-	2
14	R-	3-
18	R	3+

Regarding nutritional values, authors, referred by Gigli et al. (2001) reported that high energetic levels or feed rich in maize silage showed carcasses with low meat and higher fat content, 58.46 % and 14.45% vs 62.09% and 9.25% (respectively for meat % and fat % in tissue composition for animal fed on silage maize vs hay). Moreover, comparing anatomical region diets with higher content of greater concentrate produces a higher development in abdominal regions (table 3); on the contrary, diets with lower concentrate content develop more distal pelvic limbs (Contò et al., 2022).

Carcass quality is also influenced by slaughter age due to an increase in size, weight and development of different tissues that involve changes in body composition.

Table 3. Comparison of the development of anatomical regions according to three different diets (Contò et al., 2022).

Parameters (%)	Maize Silage	Polyphite hay	Pasture	RSME	*p*-value
Distal pelvic limb	7.19[b]	7.96[a]	8.24[a]	0.43	<0.001
Proximal pelvic limb	27.66	27.81	27.53	0.75	0.692
Loin	6.63	6.61	6.53	0.38	0.806
Abdominal region	4.68[a]	4.03[b]	3.72[b]	0.28	<0.001

Meat quality

Meat quality is evaluated by organoleptic, nutritional and health aspects, which are influenced by genetic and environmental factors. Colour and tenderness are the principal organoleptic characteristics because they directly influence the consumer's choice during buying and eating.

The colour of meat depends largely on the amount and state of myoglobin (Mb), which is a sarcoplasmic heme protein. Meat colour for each species is typical because the chemistry of myoglobin is species-specific (Ripoll et al., 2018). Myoglobin is a particular protein with an iron molecule in the centre surrounded by a tetrapyrrole ring called heme iron. In function of heme iron oxidation, the myoglobin changes in colour through three different oxidation forms: oxymyoglobin (OxyMb) responsible for cherry red colour (heme iron is binding to oxygen); deoxymyoglobin (DOxyMb) responsible for purplish colour (heme iron is bound to water), it is commonly seen in vacuum-packaged meat (this form is reversible to OxyMb and vice versa); metmyoglobin (MetMb), responsible for the brownish colour, (heme iron goes from the ferrous to ferric state), the formation of metmyoglobin is not reversible.

Buffalo meat is richer in iron compared to other species like beef and sheep, (1.83 mg/100g of meat vs 1.53 mg/100g respectively for buffalo and in means of the other species); and show also higher myoglobin content as reported in Tateo et al. (2007). Even if the high presence of iron could induce greater oxidation of meat, this element is important because it participates in a different metabolic process. Colour is influenced not only by the oxidative status of heme iron but also by the age of animals meat becomes darker with increasing age. Meat colour is evaluated by the CieLab system (Ripoll et al., 2018) which takes into account the lightness (L*), redness (a*) and yellowness (b*). Buffalo meat decreases in lightness and increases in redness with the animals' age (table 4), whilst the yellowness index increases due to marbling.

Table 4. Colour of *longissimus dorsi* muscle in buffalo at different ages (Gigli et al., 2001).

Age	Lightness L*	Redness a*	Yellowness b*
6 months	49.9	12.9	14.79
10 months	43.1	14.6	13.21
14 months	40.3	20.2	12.10
18 months	39.7	21.4	13.93

If colour is the first parameter that consumers use for buying meat, tenderness is the first parameter that consumers use to evaluate the quality during eating. Many factors influence tenderness, including pre-slaughter factors such as breed, gender, age, feeding regime and post-slaughter as processing conditions (carcass suspension), electrical stimulation, chilling, aging and eventually cooking methods and time.

Generally, four main categories are been identified as factors contributing to tenderness, just linked to the muscle's status:

1. The contractile state of the muscle, which turns into during the ageing process;
2. degradation state of muscle fibres, which occurs in the post-mortem period by proteolytic enzymes (calpains, cathepsin and so on), breaking down some of the structural components of muscle;
3. amount and solubility of connective tissue, in fact, the amount of collagen and its degree of cross-linking, is an important aspect; the more cross linkages there will be in a collagen fibre the more insoluble it becomes, and meat will be tough; for this reason, older animals, have meat toughest than younger;
4. fat content, marbling is thought to function as a lubricant on the teeth or in the mouth and decrease the amount of frictional force, furthermore fat is responsible also for aroma and flavour.

Nutritional quality

The last but not least important characteristic is nutritional quality. Nutritional value depends on different compounds such as protein, fatty acid and vitamin content.
Fatty acids are the most important because their quantity and structure of they have an impact on human health. Indeed, the saturated fatty acids (SFA) as myristic acid (C14:0), palmitic acid (C16:0) and stearic acid (C18:0), are significantly associated with human cardiovascular diseases risk; although a distinction should be made for the stearic acid (C18:0) which has been found to have little cholesterol-raising effects in humans.

Buffalo meat has a lower concentration of total SFA than beef and higher monounsaturated fatty acids (MUFA) (Gigli et al., 2001, Contò et al., 2022); as well as a higher polyunsaturated fatty acids content of beef, which improves the healthy indexes as atherogenicity (IA) and the thrombogenicity one (IT) (Di Stasio et al., 2021; Tamburrano et al., 2019); at last, buffalo meat has, also, a low cholesterol content compared to beef (48.8 mg/100g vs 53.7 mg/100g - Calabrò et al. 2014).

Meat processing

Buffalo meat can undergo processing to improve its taste or to extend its shelf life. The first type of process is "maturation" to improve the tenderness and flavour thanks to the increase of proteolysis. The effect of aging is time-dependent, some first-quality cuts, in particular loin, usually receive a prolonged aging time (PAT), but in order to avoid rancidity and microbial proliferation, various preservation techniques have been implemented. The most common ones are classified into: "dry aging" and "wet aging" (Terjung et al., 2021).

Dry aging includes maturation in a controlled environment (+2°C of temperature and 78% of relative humidity), or protected maturation with films which ensure oxygen penetration, the losses of liquids and allow an antimicrobial barrier. This process can last for weeks or even months. The anatomical cuts to

be used for prolonged aging time must, generally, be large and have an abundant layer of subcutaneous fat, as usually we have in buffalo loin (Salzano et al., 2021).
The chunk of meat dries outside making the "crust" and after a few weeks start the fibre contraction that, preventing the loss of other liquid and oxygen penetration, blocks the lipid oxidation, while proteolysis continues due to the enzyme activity, ensuring tenderness and flavour. The crust will be removed before consumption with considerable losses of the product (Terjung et al., 2021).

Among the wet aging processes, we have vacuum-packed meat maturation or meat maturation with brine. The vacuum-packed meat remains in contact with liquids, giving blood and metal taste. The flavour can be improved with the addition of brines and spices, which also show an antibacterial and antioxidant function, catching iron and improving colour (Terjung et al., 2021).

Generally, buffalo meat is subject to marked oxidation due to the high presence of pro-oxidant iron (Tamburrano et al., 2019), therefore it is essential to use suitable packaging.

Among the technologies that improve the marketing and shelf life of buffalo meat the following are highlighted: modified or protective atmosphere packaging (MAP), whose atmosphere blown inside consists mainly of 80% oxygen (O_2) and 20% carbon dioxide (CO_2); vacuum packaging and skin packaging, storage in the absence of oxygen and at last edible coat, by using hydrocolloid and lipid components. These types of packaging can be supported by using absorbent pads and films activated with antimicrobial and antioxidant substances (Jaspal et al., 2022). The presence or absence of oxygen shows advantages and disadvantages by acting on the one hand on oxymyoglobin formation and the bright meat colour, on the other hand on the oxidation of lipids. The best compromise between the two situations is given by skin packaging, which preserves the meat in an anaerobic environment, producing all the positive effects of the vacuum, but it does not allow the dripping liquids from the meat, significantly improving and extending the shelf life (Jaspal et al., 2022). However, this technology is still very expensive, and it is therefore used for small portions of raw meat, minced meat or meat preparations, which could be purchased in retail.

Buffalo meat can be used for numerous preparations involved in the drying and salting processes (Paleari et al., 2000). These cured products can be obtained with whole cuts of meat and derived from minced meat supplemented with pork fat. By way of example, we report below some processed products obtained in Italy with buffalo meat.

Bresaola

Bresaola of buffalo meat, like beef meat GPI product (EEC 1263/96) typical product of Valtellina (north Italy) is produced by salting and curing different cuts of hindquarters. A strict trimming process is essential to give a unique flavour.
Legs of beef are defatted and seasoned with a dry rub of salt and spices, such as juniper berries, cinnamon and nutmeg. They are then left to cure for a few days. The drying period is between one and three months. The meat loses up to 40% of its original weight during aging.

Carne salada

Carne salada is obtained with the topside of adult animals. The cuts, cleaned of all fat and tendinous parts, are sprinkled with a mixture of salt and other ingredients and placed in a container where they will remain from 2 to 5 weeks, depending on the size of the individual pieces. During the entire maturation period, the *carne salada* must be kept in a dark room at a maximum temperature of +12 °C and it is massaged at least every 2/3 days.

Sfilacci

The strips of meat *sfilacci* are prepared with very lean meat cut into thin slices along the fibre. It is put in brine for about 15 days and then it is seasoned for about one month and finally beaten. The meat fibres separate, and dry filaments of a deep red colour are formed.

Pastrami

Pastrami is a food originating from Romania usually made from beef brisket. The raw meat is brined partially dried, seasoned with herbs and spices, and then smoked and steamed. It is aged for three weeks.

Minced meat with pork lard

There are numerous sausages made with pork lard and buffalo meat, such as salami, suppressed and so on. The minced meat in large pieces, cut with a knife, or finely ground is added with different percentages of pork lard, spiced with pepper, fennel, coriander and so on and seasoned for different periods, obtaining a lot of different cured products.

Products based on buffalo meat are increasingly spreading, they are cooked or prepared ready to eat, like meat sauces, stews, rolls, hamburgers and so on. This could also satisfy consumer demand for lean products with a low energy content which could be well integrated into a modern diet.
Buffalo beef can be transformed into various cured products, which could be a clear economic advantage for the breeder.

References

Borghese A., Chiariotti A., Barile V.L. 2022 Chapter entitled "Buffalo in the World: Situation and Perspectives in: Springer's edited book Manmohan Singh Chauhan and Naresh Selokar (Eds): Biotechnological Applications in Buffalo Research, 978-981-16-7530-0 ISBN, 978-981-16-7531-7 (eBook).

Calabrò S., Cutrignelli M.I., Gonzallez O.J., Chiofalo B., Grossi M., Tudisco R., Panetta C., Infascelli, F. 2014. Meat quality of buffalo young bulls fed faba bean as protein source. *Meat Science*, 96:591-596. Doi: 10.1016/j.meatsci.2013.08.014

Contò M., Cifuni G.F., Iacurto M., Failla S. 2022. Effect of pasture and intensive feeding systems on the carcass and meat quality of buffalo. *Anim Biosci* 35:105-114. Doi: 10.5713/ab.21.0141.

Di Stasio L. and Brugiapaglia A. 2021. Current Knowledge on River Buffalo Meat: A Critical Analysis. *Animals*, 11: 2111. Doi:/10.3390/ani11072111

Gigli S., Failla S., Iacurto M. 2001. Valutazione delle carcasse, caratteristiche chimico-fisiche e nutrizionali della carne bufalina Atti del I Convegno Nazionale sull'Allevamento del Bufalo. Eboli 3-5 Ottobre 2001

Jaspal M.H., Badar I.H., Usman Ghani M., et al. 2022. Effect of Packaging Type and Aging on the Meat Quality Characteristics of Water Buffalo Bulls. *Animals*, 12:130. Doi: 10.3390/ani12020130.

Juárez M., López-Campos Ó., Prieto et al. 2019. Carcass Characteristics and Meat Quality of Bison, Buffalo, and Yak. In book: More than Beef, Pork and Chicken – The Production, Processing and Quality Traits of Other Sources of Meat for Human Diet 95-117. Doi:10.1007/978-3-030-05484-7_5

Paleari M.A., Beretta S., Colombo G. F., et al. 2000. Buffalo meat as a salted and cured product. *Meat Science*.54: 365–367. Doi:10.1016/s0309-1740(99)00111-4.

Ripoll G., Albertí P., Panea B., Failla S., et al. 2018. Colour variability of beef in young bulls from fifteen European breeds. *International J Food Sci Technol*. 53:2777-2785. Doi:10.1111/ijfs.13890

Salzano A., Cotticelli A., Marrone R. J., et al. 2021. Effect of Breeding Techniques and Prolonged Post Dry Aging Maturation Process on Biomolecule Levels in Raw Buffalo Meat. *Veterinary Sciences*, 8:66. Doi: 10.3390/vetsci8040066.

Tamburrano A., Tavazzi B., Callà C.AM., et al. 2019. Biochemical and nutritional characteristics of buffalo meat and potential implications on human health for personalized nutrition. *Italian Journal of Food Safety*, 8:8317. Doi:10.4081/ijfs.2019.8317

Tateo A., De Palo P., Quaglia N.C., Centoducati P. 2007. Some qualitative and chromatic aspects of thawed buffalo (Bubalus bubalis) meat. *Meat Science* 76: 352–358. Doi:10.1016/j.meatsci.2006.12.003

Terjung N., Witte F., Heinz V. 2021. The dry-aged beef paradox: Why dry aging is sometimes not better than wet aging. *Meat Science*, 172:108355 Doi:10.1016/j.meatsci.2020.108355.

BUFFALOES IN AMERICA

Patiño, E. M.[1], Crudeli, G. A.[2], Coronel Sicairos, I.[3]

[1]Asociación para la Producción y Desarrollo del Búfalo en Argentina (ABUAR). Corrientes, Argentina.

[2] Universidad Nacional del Chaco Austral (UNCAUS). Chaco, Argentina

[3]Asociación Mexicana de Criadores de Búfalos (AMEXBU). Ciudad de México, México.

Abstract

The buffalo (*Bubalus bubalis)* is currently found on all continents. It had its origin in Asia and data on its existence as a domestic animal has been recorded for 4,500 years, in the region occupied today by India and Pakistan. From Asia, it was taken to Africa, then to Europe, to Oceania and later to America (Nascimento, 1993). The American continent currently has 35 countries (Países de América, 2022). The buffalo arrived in the Americas in 1880 but it was not until 1990 that it spread to several countries in South America. Brazil first, then Trinidad and Tobago and finally Venezuela and Argentina (Patiño *et al*., 2022). The buffalo population in the entire American continent according to FAO currently would reach the sum of 1,848,137 heads and only four countries would have a buffalo population: Brazil, Colombia, Trinidad and Tobago and Suriname with 1,502,482; 338,567; 6,244 and 844 heads respectively (FAO, 2022). The objective of this paper is to try to demonstrate the number of countries that have buffaloes and the approximate number of buffaloes that exist in the American continent, also carrying out a projection to determine how many buffaloes will exist in America within 10 years.

Keywords: buffalo, population, America

Methodology

To obtain the buffalo population data in the American countries, the different associations of buffalo producers existing in America, the FAO, buffalo producers and researchers were contacted between the months of August and September 2022 (Table 1).
To determine the estimated population growth of buffaloes in the American continent, the figure of 13.1% annual population growth of buffaloes in Argentina for 10 years was taken as a reference, according to Crudeli *et al*., 2011.

Buffalo in Venezuela

Results and Discussion

Out of a total of 35 countries that make up the American continent, 23 countries have a buffalo population, reaching a total figure of 6,736,490 heads (Table 1).
At present, the buffalo is found in almost all the countries of the American continent, being the last to incorporate this species, in Canada and Chile. The main countries with several heads are Brazil, Venezuela, Colombia and Argentina.
The buffalo breeds bred in the American countries are Murrah, Mediterranean, Jafarabadi, Buffalypso, Carabao and their crosses.

Buffalo in Guatemala

Table 1. Buffalo population in American countries

N°	Country	Buffaloes	Source of information
1	Brazil	3.000.000	Asociación Brasilera de Criadores de Búfalos
2	Venezuela	2.800.000	Criabúfalos. Asociación Civil Criadores de Búfalos de Venezuela
3	Colombia	551.000	Asociación Colombiana de Criadores de Búfalos
4	Argentina	146.895	Servicio Nacional de Sanidad Animal (SENASA)
5	Mexico	56.000	Asociación Mexicana de Criadores de Búfalos
6	Cuba	51.100	Alina Mitad. Sociedad Cubana de Criadores de Búfalos
7	Bolivia	50.000	Luis Quiles Skorc. Asociación de Criadores de Búfalos de Bolivia
8	Costa Rica	15.000	Asociación Costarricense de Criadores de Búfalos
9	Guatemala	15.000	Sucel Molina. Asociación de Criadores de Búfalos de Guatemala
10	Paraguay	13.125	Asociación Paraguaya de Criadores de Búfalos
11	Ecuador	10.000	Stefania Olsen. Hacienda La Victoria
12	Panamá	10.000	Asociación Nacional de Búfaleros de Panamá
13	Trinidad and Tobago	6.244	FAO
14	USA	3.000	Thomas Olson. The American Water Buffalo Association
15	Canada	2.500	Martin Littkemann & Lori Smith. Ontario Water Buffalo Company
16	Honduras	1.500	Marco Zava. Productor and investigador
17	Peru	1.500	Marco Zava. Productor and investigador
18	Uruguay	1.000	Marco Zava. Productor and investigador
19	Surinam	844	FAO
20	Nicaragua	800	Cesar A. Leiva. Ganadería Leiva
21	Belize	632	Anthony P. Leonard. Tender Buff
22	El Salvador	250	Eliu Cecilia. Productor
23	Chile	100	Marco Zava. Productor e investigador
Total		**6.736.490**	

Buffalo in Brazil

If we take as a reference the buffalo population estimated at 6,736,490 heads for the year 2022, and if we consider the figure of 13.1% annual population growth of buffaloes in Argentina for 10 years (Crudeli *et al*., 2011) and we extrapolate it, in the American continent an estimated population of 21,315,348 buffaloes would be reached in the year 2032. Therefore, the buffalo culture in America has a very promising future.

Conclusions

As can be seen, the data obtained in our work shows that the number of countries and a total number of buffaloes is much higher than the data published by FAO, which is undoubtedly very far from reality. It would be advisable for the governmental authorities of the American countries to regularize the updated data of their respective buffalo populations and send them to FAO.

References

Crudeli G. A. 2011. Fisiología reproductiva del búfalo. Producción en Argentina. Tecnología en Marcha, Vol. 24, N.° 5, *Revista Especial* P. 74-81.

FAO. 2022. FAOSTAT. https://www.fao.org/faostat/es/#data/QCL

Nascimento C. 1993. Generalidades. En: Criação de Búfalos: Alimentação, Manejo, Melhoramiento e Instalaçoes. Capitulo I, Introducción 1-9. Empresa Bubalinocultura de las Américas Brasileira de Pesquiza Agropecuaria, Centro de Pesquisa Agroforestal da Amazonia Oriental- Brasilia – SPI . 403 p.
Países de América. 2022. https://www.saberespractico.com/geografia/paises/paises-de-america/

Patiño E.M., Crudeli G.A., Mitad Valdez M.A., Coronel Sicairos I. 2022. En: El Búfalo en América. Cap. 1: 32-34. Libro Bubalinocultura de las Américas. 3rd Edition. In press

Servicio Nacional de Sanidad Animal (SENASA) Argentina. 2022. Información Pública. https://www.argentina.gob.ar/senasa. Information: infopublica@senasa.gob.ar

Buffalo in Venezuela

BUFFALOES IN MEXICO

Coronel, S. I. [1]; Patiño, E.M[2]., Crudeli, G, A[3]

[1]Asociación Mexicana de Criadores de Búfalos (AMEXBU). Ciudad de México, México
[2]Asociación para la Producción y Desarrollo del Búfalo en Argentina (ABUAR). Corrientes, Argentina
[3] Universidad Nacional del Chaco Austral (UNCAUS). Chaco, Argentina

Abstract

The water buffalo *(Bubalus bubalis*) was introduced in Mexico in the mid-1980s through imports from Guatemala. Currently, the buffalo population is estimated at 50,000 head distributed in 29 of the 32 states that make up the national territory. The states with the largest buffalo population are Campeche, Tabasco, Oaxaca and Veracruz. There are currently 200 buffalo farmers across the country. If the current buffalo population in Mexico were projected taking into consideration an annual organic growth of 13.1%, the buffalo population would grow to about 171,233 in 10 years.

Keywords: buffalo population, producers, Mexico

Past

There are indications that in the 1980s, buffalo were imported from Guatemala to Mexico, which were taken to the coast of the state of Jalisco and the mountains of the state of Zacatecas, but there are no records because they were introduced as cattle. They were small batches and there was no history of their presence in Mexico, so it is assumed that they were all slaughtered at some point.

In the same years, Mr Anthony Leonards imported Carabao buffalo into the United States of America from the island of Guam (a US colony in the western Pacific). He also tried to import a batch of buffaloes of the Bufalypso breed from Trinidad and Tobago, but the government of his country prohibited their importation since the buffaloes showed the presence of the Bluetongue virus in blood tests. For this reason, the importer negotiated to leave them in a quarantine station in Belize, so that the ship would not return to Trinidad and Tobago. The buffalo remained in Belize for 9 years.

Subsequently, the Mexican animal health authorities granted permits, so that this batch of buffalo in Belize could transit through the country to reach the United States; however, the necessary permits were not obtained from the US authorities to import them.

For this reason, Leonards requested the help of the Maitret family from Mexico to transport them through their properties in the states of Veracruz and Chiapas. It took six years to convince the Mexican authorities that the strain of Bluetongue virus carried by buffaloes was asymptomatic for sheep in the US. During that period Leonards decided to sell his farms located in the states of Arkansas and Missouri and transported the 648 buffalo that were there, to Mexico, to the state of Chiapas.

In other words, the buffalo that came to Mexico are descendants of those that came to the US from the islands of Guam and Trinidad and Tobago; but they are also descendants of two Mediterranean buffalo sires that were brought from Italy to the state of Florida.

Leonards subsequently imported doses of semen from Murrah and Jafarabadi breeds from Brazil, although the latter's semen was lost due to lack of care in US farms. Of all this, only verbal memory remains since there are no records that certify it.

Between 1991 and 1992, the Maitret family imported into Mexico a buffalo herd of 468 buffalo made up of bulls, females and their calves from the US, which was cross-bred made up of a racial mixture of Carabao, Bufalypso, Murrah and Mediterranean.
Eventually, in 1993, the Mexican authorities granted permits to import 2,562 Bufalypso buffaloes from Belize; whose original herd came from Trinidad and Tobago. The animals were located in the state of Chiapas.
For the first ten years, the Maitret family dedicated themselves to the raising of buffalo. On their farms in Chiapas, the buffalo gradually displaced the cattle. The females were not sold and with the males, they slowly opened markets for the commercialization of the meat. The size of the herd went from 3,030 heads imported from the US and Belize to more than 6,000 animals. But unfortunately, milk production was completely neglected.

Present

In 2006, the Mexican Association of Buffalo Breeders (AMEXBU) was founded in the city of Campeche, Free and Sovereign State of Campeche, under
the presidency of Mr Ismael Coronel. The aforementioned association currently has 200 buffalo producers.
In 2017, the IX Symposium on Buffaloes of the Americas and Europe was held in Campeche with the participation of producers, technicians and researchers from 15 countries, from America, Europe and Asia.

According to data from the AMEXBU, the buffalo population in Mexico is currently 50,000 heads with a presence in 29 out of the 32 Mexican states. The greatest growth has been registered in the Mexican southeast, in states such as Campeche, Tabasco, Oaxaca and Veracruz and recently in Nayarit, Jalisco and Aguascalientes.
Most of the Mexican buffalo population is found in the tropics and subtropics in the south of the country (Veracruz, Tabasco, Campeche, Chiapas), with almost permanent average temperatures of 34 to 36°C and rainfall of 1,800 to 2,000 mm. annual. In this region (in the natural field) an average daily gain of 600 grams in live weight is achieved, reaching 450 kilos at 28 months of age. In addition, an average production of 5-6 litres of milk per day is obtained (Zava, 2017).
The Mexican company "Búfalos de México" has several years of experience both in the breeding and reproduction of buffalo, as well as in the marketing of meat and dairy products. Their products have penetrated significantly in the national market due to their high quality. Among its clients, there are gastronomic companies and hotel chains, including those distinguished in gourmet products.
Buffalo meat products include American cuts, dry sausages (salamines) and fresh sausages (chorizos). Among buffalo dairy products, fresh and matured cheeses such as mozzarella, fresco, manchego, asiago, taleggio, crescenza, arglotino, provolone, portsalud and parmesan should be mentioned, as well as yoghurt, *dulce de leche* and ice cream. The current demand for buffalo milk, meat and buffalo products has been growing steadily, but growth is limited on the supply side.

It is also worth mentioning the action carried out by the AMEXBU promoting the breeding of buffaloes to women dedicated to field activities under the "Buffalo Woman" project. This Program is for sharecropping and training in the production of dairy and meat products. The pregnant buffaloes are property of AMEXBU, but the calves that are born within a period of three years or more, as established in the agreement they sign, are distributed in equal parts within the associates and the lot that was given to them will be returned, so that this program can be launched in other municipalities of the same state or other states (Sanchez, 2021)

The training for producers and technicians began in 2022 when the first "Diploma in Buffalo Production" was issued, organized by the School of Permanent and Lifelong Education, of the Olmec University of the State of Tabasco and sponsored by AMEXBU and ABUAR.

Future

The possible improvements to the buffalo production systems go beyond the technical-productive aspects since market conditions must also be considered and the corresponding sanitary and safety standards included, highlighting buffalo products' qualities. These actions could be accompanied by dissemination campaigns so that consumers know the peculiarities of the products and by-products of this species.

To promote buffalo products acceptance, the academic sector must broaden and deepen its research on buffalo breeding, management and use. Both basic and experimental information is required on the productive potential of the species, as well as the development of technologies to increase the productivity of farms, from a sustainable development perspective. In addition, more efficient schemes of organization and access to markets are needed that allow producers to generate higher incomes and favour the regional development of tropical areas that allow it (Mendoza et al. 2019).

Conclusions

If we take as a reference the population of buffalo estimated by AMEXBU at 50,000 heads for the year 2022, and we consider the figure of 13.1% annual population growth of buffalo in Argentina for 10 years (Crudeli et al. 2011) and extrapolate it to Mexico, a buffalo population of 171,233 heads would be reached in this country in the year 2032. Therefore, the buffalo culture in Mexico points to a very promising future.

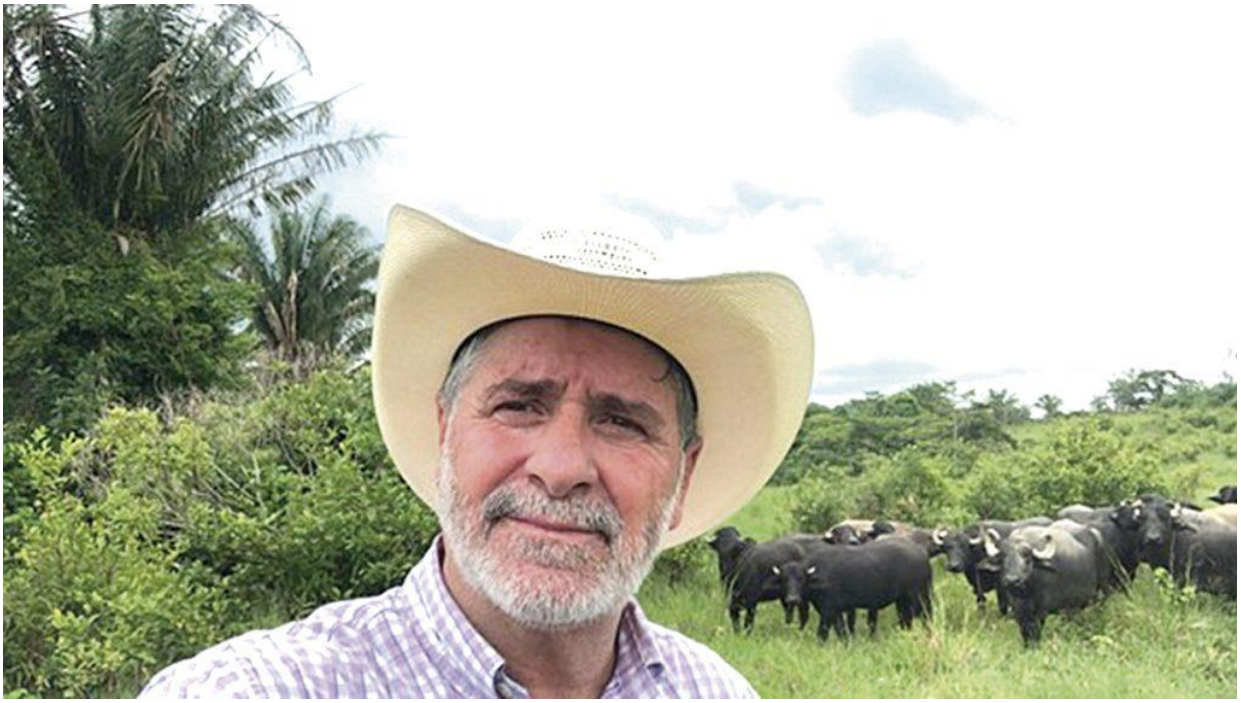
References

Crudeli G. A. 2011. Fisiología reproductiva del búfalo. Producción en Argentina Tecnología en Marcha, Vol. 24, N.° 5, *Revista Especial* P. 74-81

Mendoza A.B, Álvarez Macías A., Mota Rojas D. 2019. Desempeño productivo de los búfalos y sus opciones de desarrollo en las regiones tropicales. Sociedades Rurales, Producción y Medio Ambiente No. 38: Págs. 59-80. https://publicaciones.xoc.uam.mx/Busqueda.php?Terminos=Aldo%20Bertoni%20Mendoza&TipoMaterial=1&Indice=2

Sanchez G. 2021. Benefician productoras de Oaxaca con el Proyecto "Mujer Bufalera". Enfoque Agropecuario . https://enfoqueagropecuario.com/2021/10/16/benefician-productoras-de-oaxaca-con-el-proyecto-mujer-bufalera/

Zava M. 2017. Búfalos: México será sede de un encuentro global de productores. Sitio Argentino de Producción Animal. https://www.produccion-animal.com.ar/informacion_tecnica/razas_de_bufalos/126-Bufalos-Mexico.pdf



Ismael Coronel and the buffaloes of Mexico

Ismael Coronel and participants of the "Buffalo Women" program.

CUBAN BUFFALO PRODUCTION

Alina Mitat Valdès

Asesora del Centro de Investigacion para el Mejoramiento Animal de la Ganaderia Tropical
Former Professor at Faculty of Veterinary Medicine – Agraria University
La Habana, Cuba

Herd´s Origin

The first Buffalypso herd was introduced from Panama, which in turn was originally from Trinidad and Tobago; however, the supply of a number of heads of this breed was insufficient to the needs of the development program for the species, so, it was necessary to import buffaloes Swamp (or Carabao) from Australia, during the years 1983-1989.

There were acquired a total of 2,984 animals from uncontrolled herds following the sanitary requirements demanded by Cuba for the entry of animals.

Evolution of the absorption program of Carabao females to the Riverine subspecies

Upon the arrival of the Carabao, the guidelines of the Genetic Improvement Program were designed to obtain animals with dairy characteristics. The program was based on the maintenance and improvement of 100% of riverine animals, the maintenance and improvement of 20% of swamp animals, as well as the absorption of 80% of swamp females towards the Riverine subspecies, with evaluations of the F_1 Riverine x Swamp, R_1 ¾ Riverine x ¼ Swamp and 5/8 Riverine x 3/8 Swamp crosses.

Swamp's female absorption crossbreeding program began in August 1987. Buffalypso sires were assigned to these herds and all of them were organized into large herds.

Various factors influenced the development of this program, including:

- ✓ Start of the large-scale program at the beginning of the period of economic depression in the country, in 1990, which was called the "Special Period". From 1959 up to that moment livestock cattle, pigs and poultry were the main programs that had been developed. At that time their herds and production began to decline significantly, which motivated most of the efforts and material resources to be dedicated to curbing this trend, the buffalo herds were left practically to spontaneous development.
- ✓ Location of herds in coastal and/or flooded areas with adverse conditions for the different breeding systems and increased maintenance and organization costs.
- ✓ Ignorance of the characteristics of buffaloes with a zootechnical treatment similar to that given to cattle, even though they are not the same species, with different histories of adaptation, artificial selection and management.
- ✓ The insufficient and extremely limited capacity of the producers, which in many cases did not correspond to the conditions of the production systems for the tropics.

The extensive herds were characterized by:

1. Semi-wild animals due to the little relationship with a man.

2. Absence of zootechnical flow, decreased food supply, increased male/female ratio with its negative effect on the organization and management of the animals, and the lack of individual and population control. This caused, among other difficulties, the uncontrolled exodus of animals, loss from the beginning of the genealogical and productive information of the new generations of the crossbreeding program, and bad reputation of the species among farmers and other managers, which led to the rejection of buffalo exploitation, in some sectors.
3. Simultaneous and uncontrolled presence in the absorbent crossbreeding program of purebred and crossbred bulls: Carabao (born in Cuba from buffaloes that came pregnant from Australia), Buffalypso (that were previously introduced), F_1 animals and successive uncontrolled crosses (that were born in the herds).

Starting in 2007, small quantities of semen of the Mediterranean breed were imported from Italy, whose objectives were to reduce the consanguinity of the herd (Acosta et al., 2014) and to introduce genes from highly specialized breeds in milk production, using later crossbred sires of that breed with the buffaloes born in Cuba.

Genetic structure of the buffalo population

The Cuban buffalo herd is characterized by an indiscriminate mix of subspecies and breeds. The results of the structure analysis using a Bayesian approach (Pritchard et al., 2000) and implemented in the STRUCTURE software, allowed for the distinction of three groups of animals in the population, grouped in K = 3 (Figure 1). The result of the STRUCTURE analysis corresponds to the genetic origin of the Cuban population, in which genes from the River "Buffalypso" breed and Swamp buffaloes (Carabao) have intervened, plus the recent introduction of Mediterranean genes in the Cuban population. (Acosta et al., 2014). The figure clearly shows the presence of three types of gene sets, corresponding to the colored bars (red, green and blue). It is not possible to associate each color to a specific genotype because the analysis carried out did not include samples corresponding to the breeds that gave rise to the Cuban Buffalo. It can only be inferred that there is a minority presence of genes from the Mediterranean breed (blue bars), which is also associated with the recent introduction of that breed in the study population.

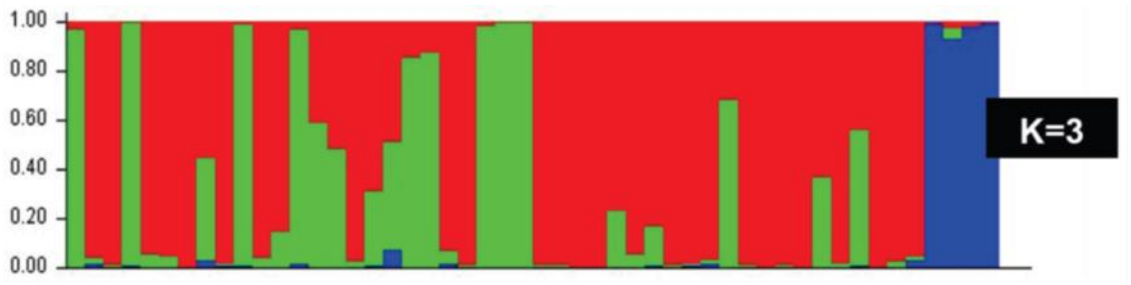


Figure 1. Estimated structure of the buffalo population; each individual is represented by a vertical line, which is divided into coloured segments that represent the proportional contribution of the deduced K groups.

Although the Buffalypso breed has in itself Murrah and Jaffarabadi genes, the participation of the Carabao in the Cuban buffalo could be the cause that when estimating the genetic relationships between the mixed population and two herds from Brazil (Murrah and Jaffarabadi) through nine microsatellite

markers, the UPGMA dendrogram based on Nei's genetic distance (DA), will show two groups (figure 2): one included Cuban buffaloes and the other included Brazilian populations. Grouping by Bayesian methods reinforced previous results on the genetic composition of the buffalo population in Cuba (Martínez et al., 2015).

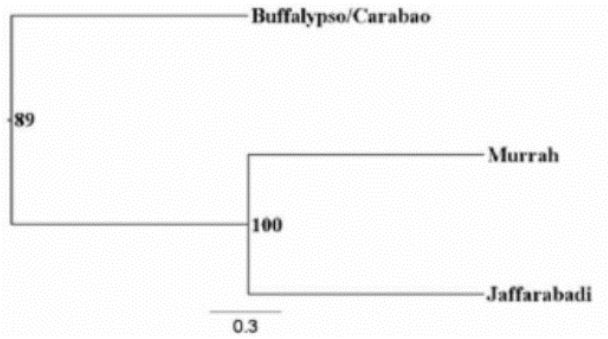


Figure 2. UPGMA dendrogram based on the genetic distance of Nei, DA, showing the clustering of populations into two groups. The numbers indicate the proportion of replicates that shared the node in the resampling.

Herd of the El Cangre company, Mayabeque province.

Moncada sire, Mediterranean x mixed buffaloes (Buffalypso x Carabao), El Cangre company, Mayabeque province.

Population, productive activity and production systems

At the end of 2021, the buffalo population amounted to 51,100 heads, distributed throughout the country. 64.1% of the animals were concentrated in the provinces of Artemisa, Mayabeque, Villa Clara, Sancti Spíritus and Camagüey. State companies are the largest owners of this species, with 90.5% of the national herd.
Milk production is obtained from 208 dairy farms, last year they reached 4.7 Mil L, while the meat comes from 43 breeding herds and 14 extensive ones, which contributed 3,500 Mil T to the national economy.

The reproductive system continues to be the natural mating.

Between 8 and 10 days after giving birth, the buffaloes are incorporated into manual milking, which is done once a day, in the morning with the support of the calf, which is left room for feeding. Neither before nor during milking are mothers offered food, only water in the waiting pen.

The feeding of the milking mothers is based on natural pastures: "paraná" (*Brachiaria mutica*), "sacasebo" (*Paspalum notatum*), "espartillo" (*Sporobolus indicus*) and "caguazo" (*Paspalum virgatum*), "jiribilla", "pitilla" (*Dichantium aristatum, annulatum, caricosum* and *Botriochloa pertusa*), and small areas of introduced grasses common pangola (*Digitaria decumbens*) and coastal bermudagrass (*Cynodon dactylon*), jaragua (*Hyparrhenia rufa*), common "guinea" and "likoni" (*Panicum maximum*) and star

grass (*Cynodon nlemfuensis*). In the less rainy season, they were supplemented with king grass (*Pennisetum purpureum* x *Pennisetum typhoides*) forage.

The individual measurement of milk production is carried out between 28 and 32 days, on the day of the control (weighting) milking is carried out thoroughly, so that the milk that is calculated is considered as the total production of the female, without taking into account what the buffaloes consume. The control of the milk production of the buffaloes consists of a monthly sampling without control of fat.

Future sires for natural mating
Ganadera company, Camagüey province

Milk production per lactation

The productions of 9,089 buffaloes, which were lactating in 187 herds in all the provinces of the country, between the years 2012 and 2019, whose lactation numbers were between the first and the 15th, indicated that on average, they produced 639.02 kg of milk in 220.16 days (Mitat, 2021).
Among the causes of these production levels, there is the production system, feeding with unimproved natural pastures and inefficient supplementation, lack of training for milking, minimal selection for production and marked deficiencies in the economic systems of the units themselves and of the country.

However, under our environmental conditions, which include current and future economic conditions, it may not be a logical objective to increase individual performance, but to increase production volumes by having more milking buffaloes organized in small herds, with better care in all areas of animal husbandry, with related economic systems.

Buffalo cow and her calf, Ganadera company, Camagüey province.

Meat production

The efficiency in meat production of this species, at an experimental level, shows satisfactory results. The productive behaviour, yield and composition of the carcasses of morphologically Buffalypso buffaloes, crossbreeding of Carabao, Siboney de Cuba crossbreed cattle (5/8 Holstein x 3/8 Zebu) and commercial Zebu, with initial live weights of 170, 184, 201 and 209 kg respectively, were compared. The Buffalypso showed 624 g, the Carabao 506 g, the Zebu males 438 g and those of the Siboney breed 428 g of weight daily gain. The yield of carcasses in Buffalypso and Carabao respectively was lower (50.0 and 50.2%) as well as meat yield (62.2 and 61.6%), compared to bovines, whose values were 51.2 and 51.1 and 65.4 and 65.0% for the Siboney and Zebu respectively. Meat production per surface unit tended to increase in the Buffalypso (78.2 kg ha^{-1}) compared to the Carabao (67.5 kg ha^{-1}), the Zebu (67.5 kg ha^{-1}) and the Siboney (64.7 kg ha^{-1}). These results allowed us to conclude that in natural pastures the Buffalypso performed better than the Carabao and the cattle under study.

For the production of meat on a commercial scale, it is essential to increase the herds destined for this purpose, which makes it possible to slaughter young animals, which would cause a radical change in the opinion of consumers about the quality of this product.

Production and marketing of dairy and meat products

Larger-scale production of dairy products began recently, in new mini-industries owned by state-owned companies and private producers. Examples of these are:

Finca Vista Hermosa, Havana. It is a local development project, located to the east of the capital. It produces dairy products from buffaloes, sold directly on the farm or in an establishment in the city of Guanabacoa.

Yoghurt produced at Finca Vista Hermosa

Products of the Lácteos Rojas mini-industry

Lácteos Rojas, Mayabeque province. It is the first microenterprise of its kind in Cuba that sells products derived from buffalo milk, such as ice cream, yoghurt and cheese. The venture began in 2021 as a local development project and later became a dairy micro, small and medium size enterprise (MSME), in addition to these derivatives, "it intends to incorporate a new production of probiotic yoghurt, aimed especially at vulnerable people and children and the elderly in the community, in collaboration with the science centres Institute of Animal Science (ICA) and the National Center for Agricultural Health (Censa)". The unique partner of Mipyme (MSME), Roberto Rojas Fernández, explained that "a part of the products that are made are sold directly to the Ministry of Domestic Trade, and the rest is marketed directly to the population surrounding the mini-industry, which has given them a very good acceptance of derivatives". The Cuban entrepreneur assured that "producing from within is his family's maxim" thanks to which "in less than a year as private entrepreneurs they have achieved part of their purposes, including favorably impacting the lives of the inhabitants of Güines, Mayabeque Province".

*El Cangre Genetic Livestock Company***,** Mayabeque province. It markets dairy and meat products, and the latter is sold as beef (buffalo).

Ice cream and cuts of meat produced in the company El Cangre

Macún Livestock Company, Villa Clara province. It has a herd dedicated to the production of meat in the first instance. Its products include Blanched sausages, Mortadella Macún, Mortadella special, Hamburger, Jamonada especial, Jamonada Macún, Sausage, Smoked sausages, Natural sausage, Chorizo Macún and Creole blood sausage.

Undoubtedly, the buffalo activity has a promising future in Cuba, it is encouraging that one of the main objectives of its breeding, the commercialization of its products, is beginning to be known among the population. When there is still much to be perfected in terms of the different production systems, the Ministry of Agriculture is committed to the development of the species.

References

Acosta A., Uffo O., Sanz A., et al. 2014. Genetic characterization of the Cuban water buffalo population using microsatellite DNA markers. *Buffalo Bulletin*, 33, 1: 101-106.

Fundora O., Fernández D., Sarduy L., and González M. E. 2016. Productive performance and carcass yield of grazing water buffaloes (Bubalus bubalis) and bovine cattle in the growing-fattening stage. *Cuban Journal of Agricultural Science*, 50th Anniversary, 50 (4): 579-585. http://scielo.sld.cu/pdf/cjas/v50n4/cjas06416.pdf

Martínez N., da Silva E.C., Mitat, A. et al. 2015. Genetic relationships between Cuban and Brazilian buffaloes (Bubalus bubalis) by microsatellite markers. *Rev. Salud Animal*, 37 (3): 152-163.

Mitat A. & Rodríguez M. 2021. Evolución de la producción de leche de las búfalas en Cuba (subespecie de Río, Buffalypso y Mediterránea y de Pantano o Carabao). *Ciencia y Tecnología Ganadera*, 15:3.

Pritchard, J. K., Stephens, M., & Donnelly, P. 2000. Inference of Population Structure Using Multilocus Genotype Data. *Genetics*, 155(2): 945–959.

RECENT DEVELOPMENTS IN BUFFALO REPRODUCTION

animals

A special issue of Animals (ISSN 2076-2615) belonging to the section "Animal Reproduction".

Dear Colleagues,
The global buffalo population is continuously increasing. More than 95% of the population is in Asia, where buffaloes play a prominent role in rural livestock production. It is also well-developed in the Mediterranean area and Latin America, and in recent decades several herds have also been introduced in Central/Northern Europe. Reproductive efficiency is the primary factor affecting livestock production and productivity, and it is hampered in buffalo by seasonality. Female buffaloes show variation in reproduction activity and fertility, with distinct breeding and nonbreeding seasons. During the last several decades, considerable attention has been focused on the reproductive physiology of buffalo and the factors affecting its behaviour. Based on this knowledge, different biotechnologies have been developed to improve the reproductive efficiency of both males and females.

The aim of this Special Issue is to bring together original research papers and reviews on basic and applied aspects of buffalo reproduction, both in males and females, possibly using new and multidisciplinary approaches, as well as studies on the application of classical and innovative technologies for reproduction control to optimize the management of buffalo herds.

Dr. Vittoria Lucia Barile
Guest Editor

Council for Agricultural Research and Agricultural Economy Analysis, CREA - Research Centre for Animal Production and Aquaculture, 00015 Monterotondo, Rome, Italy
Interests: farm animal reproduction; buffalo reproduction

Dr Olimpia Barbato
Guest Editor

Department of Veterinary Science, University of Perugia, Via San Costanzo 4, 06126 Perugia, Italy
Interests: animal physiology; physiology of reproduction; animal endocrinology; ruminant reproduction; follow-up of pregnancy and trophoblast well-being; buffalo.

Published Papers (9)

1. Interferon Tau (IFNt) and Interferon-Stimulated Genes (ISGs) Expression in Peripheral Blood Leukocytes and Correlation with Circulating Pregnancy-Associated Glycoproteins (PAGs) during Peri-Implantation and Early Pregnancy in Buffalo Cows

Anna Beatrice Casano, Vittoria Lucia Barile, Laura Menchetti , Gabriella Guelfi, Gabriele Brecchia, Stella Agradi, Giovanna De Matteis, Maria Carmela Scatà, Francesco Grandoni and Olimpia Barbato

Animals **2022**, *12*(22), 3068; https://doi.org/10.3390/ani12223068

The objective of this study was to analyze interferon-stimulated genes (ISGs) and interferon tau (IFNt) gene expression in peripheral blood leukocytes during the peri-implantation period and until 40 days of pregnancy in buffalo cows. Relationships were also examined between **[...] Read more.**

2. Use of GnRH Treatment Based on Pregnancy-Associated Glyco-Proteins (PAGs) Levels as a Strategy for the Maintenance of Pregnancy in Buffalo Cows: A Field Study

Corrado Pacelli, Vittoria Lucia Barile, Emilio Sabia, Anna Beatrice Casano, Ada Braghieri, Valeria Martina and Olimpia Barbato

Animals **2022**, *12*(20), 2822; https://doi.org/10.3390/ani12202822
The study aimed to evaluate the effects of GnRH administrated on day 35 after artificial insemination (AI) on the reproductive performance of buffalo cows. In ten buffalo farms in the period January–February, 481 buffalo cows were subjected to estrus synchronization **[...] Read more.**

3. Comparative Proteomic Analyses of Poorly Motile Swamp Buffalo Spermatozoa Reveal Low Energy Metabolism and Deficiencies in Motility-Related Proteins

Runfeng Liu, Xingchen Huang, Qinqiang Sun, Zhen Hou, Weihan Yang, Junjun Zhang, Pengfei Zhang, Liangfeng Huang, Yangqing Lu and Qiang Fu

Animals **2022**, *12*(13), 1706; https://doi.org/10.3390/ani12131706
The acquisition of mammalian sperm motility is a main indicator of epididymal sperm maturation and helps ensure fertilization. Poor sperm motility will prevent sperm cells from reaching the fertilization site, resulting in fertilization failure. To investigate the proteomic profiling of normal and poorly **[...] Read more.**

4. Follicular Dynamics during Estrous Cycle of Pubertal, Mature and Postpartum Crossbred (Nili Ravi × Jianghan) Buffaloes

Adili Abulaiti, Umair Riaz, Zahid Naseer, Zulfiqar Ahmed, Guohua Hua and Liguo Yang

Animals **2022**, *12*(9), 1208; https://doi.org/10.3390/ani12091208
The follicular dynamics is used as a reliable indicator for reproductive management in livestock. However, the follicular dynamics (follicle wave emergence, estrus cycle length, diameter of dominant follicle, follicular growth and atretic phases) during the estrous cycle of crossbred (Nili Ravi-Jianghan) buffalo is **[...] Read more.**

5. Quercetin Alleviates Endoplasmic Reticulum Stress-Induced Apoptosis in Buffalo Ovarian Granulosa Cells

Weihan Yang, Runfeng Liu, Qinqiang Sun, Xingchen Huang, Junjun Zhang, Liangfeng Huang, Pengfei Zhang, Ming Zhang and Qiang Fu

Animals **2022**, *12*(6), 787; https://doi.org/10.3390/ani12060787 - 20 Mar 2022
Endoplasmic reticulum (ER) stress plays a crucial role in granulosa cell (GCs) apoptosis, which is the main cause of follicular atresia. Quercetin (QC), a plant-derived flavonoid, has antioxidant, anti-inflammatory, and other biological properties. However, whether QC can alleviate the effects of ER stress **[...] Read more.**

6. Adaptive and Biological Responses of Buffalo Granulosa Cells Exposed to Heat Stress under In Vitro Condition

Marwa S. Faheem, Nasser Ghanem, Ahmed Gad, Radek Procházka and Sherif M. Dessouki

Animals **2021**, *11*(3), 794; https://doi.org/10.3390/ani11030794 - 12 Mar 2021
The steroidogenesis capacity and adaptive response of follicular granulosa cells (GCs) to heat stress were assessed together with the underlying regulating molecular mechanisms in Egyptian buffalo. In vitro cultured GCs were exposed to heat stress treatments at 39.5, 40.5, or 41.5 °C for [...] Read more.

7. Reproduction and Fertility of Buffaloes in Nepal

Bhuminand Devkota, Shatrughan Shah and Gokarna Gautam

Animals **2023**, *13*(1), 70; https://doi.org/10.3390/ani13010070 - 24 Dec 2022
Water buffalo (*Bubalus bubalis*) in Nepal contributes 57% of the total milk and 36% of the total meat production in the country. The productive efficiency of Nepalese buffaloes is quite low, due mainly to subfertility and infertility. Delayed puberty and prolonged [...] Read more.

8. Dairy Buffalo Behavior: Calving, Imprinting and Allosuckling

Daniel Mota-Rojas, Andrea Bragaglio, Ada Braghieri, Fabio Napolitano, Adriana Domínguez-Oliva, Patricia Mora-Medina, Adolfo Álvarez-Macías, Giuseppe De Rosa, Corrado Pacelli, Nancy José and Vittoria Lucia Barile

Animals **2022**, *12*(21), 2899; https://doi.org/10.3390/ani12212899 - 22 Oct 2022
Maternal behaviour, in water buffalo and other ruminants, is a set of patterns of a determined species, including calving, imprinting, and suckling. This behaviour is mainly triggered by hormone concentration changes and their interactions with their respective receptors in the brain, particularly oxytocin. [...] Read more.

9. Neurophysiology of Milk Ejection and Prestimulation in Dairy Buffaloes

Fabio Napolitano, Ada Braghieri, Andrea Bragaglio, Daniela Rodríguez-González, Patricia Mora-Medina, Marcelo Daniel Ghezzi, Adolfo Álvarez-Macías, Pamela Anahí Lendez, Emilio Sabia, Adriana Domínguez-Oliva, Joseline Jacome-Romero and Daniel Mota-Rojas

Animals **2022**, *12*(19), 2649; https://doi.org/10.3390/ani12192649 - 02 Oct 2022
The present review aims to integrate the anatomical characteristics of the mammary gland and the neurophysiology of milk ejection to understand the milking capacity of the water buffalo. Since one of the main uses of this species is milk production, this article will [...] Read more.

REPORTS

THE X BUFFALO SYMPOSIUM OF THE AMERICAS AND EUROPE

The X Buffalo Symposium of the Americas and Europe took place in Asuncion Paraguay from 15 to 18 November with the participation of over 180 delegates from Italy, Canada, Mexico, Guatemala, Costa Rica, Cuba, Panama, Venezuela, Colombia, Ecuador, Bolivia, Argentina, Brazil and a large Paraguayan contingent.

The event was held in Paraguay, located in the heart of South America, between Brazil, Argentina and Bolivia. It is a landlocked Mediterranean country, which is characterized by being the fifth-largest exporter of meat in the world and the third in the export of soybeans. It houses large territories of swampy areas, subtropical forests and Chaco. It fuses two cultures: European and Guarani. And an interesting fact to share: it is the country best qualified by the US in terms of security issues in the region to travel.

The meeting was also accompanied by important government authorities, such as the general director of the Investment and Export Network of Paraguay, the Vice Minister of Livestock, the President of SENACSA (Paraguay´s agency Quality for Animal Health), the President of the Rural Association of Paraguay, the General Secretary of the American Buffalo Federation and the General Secretary of the International Buffalo Federation.

In her speech, Gilda Arréllaga, General Director of REDIEX, Paraguay´s agency for the promotion of investments and exports (www.rediex.gov.py), stressed that the government of Paraguay supports not only the X Symposium, but the enhancement of the buffalo production chain in the country and affirmed that it will declare the buffalo productive chain as one of institutional interest. She invited all attendees to discover the country, and its productive potential, and to take into account that it offers one of the most business-friendly environments in the region.

Indeed, a few days after concluding the meeting, the Minister of Industry and Commerce, Luis Alberto Castiglioni, through ministerial declaration No. 12/2022, promoted the buffalo value chain as of institutional interest, for its contribution to the development of regenerative livestock in waterlogged and marginal fields in a sustainable manner and harmony with the environment. To diversify the production and export of domestic meat products.

Mr Pedro Galli, President of the Rural Association of Paraguay also highlighted the benefits of Paraguay. He stated that it offers great opportunities, that it has everything it takes to produce and that, therefore, it is 100% prepared for production because of its natural potential. He also highlighted the importance of effective collaboration between the public and private sectors, which has allowed the implementation of significant projects that have produced cross-sectoral benefits for the country. He also mentioned that it is important to bring awareness to the fact that Paraguay's production is environmentally friendly, socially inclusive and economically profitable. He concluded by saying that Paraguay is a safe market

for investments, has a low tax burden and has extensive government cooperation through laws and institutions that facilitate the establishment of investments.

For his part, the Deputy Minister of Livestock said that the government has formed a working and competitiveness table for the private sector to work together with the public sector so that they can strengthen and take advantage of the benefits offered by buffalo, as well as consider that this animal and its products are valued by both the government and consumers.

Training, networking, auction and field trip

The meeting, which took place over 5 days, from November 14 to 18, began with a pre-symposium, two days of academic days and two field trips.

More than 30 speakers, on 6 major topics, spoke about the past, present, and future, values and management of buffalo, reproductive innovation, tools for sustainable and modern livestock, and success stories in the region regarding buffalo, breeding, and production of valued added meat and dairy products for local and international markets.

In her lecture, Professor Gladis Rebak said FAO has shown that buffalo produces less carbon dioxide and greenhouse gases. This species also produces less methane and nitrous oxide, which are the other gases associated with livestock and the greenhouse effect.

On the other hand, Dr Juan Carlos Gutiérrez, a Venezuelan expert, based in Germany, said that the Bubalus bubalis species is an emerging species that can produce high-quality meat and dairy products. He indicated that, according to the FAO, it has shown much higher growth than all other species. Additionally, the growth of the bubaline industry in terms of dairy products and their derivatives is also higher than in other species (the bubaline industry grew 4.1%, versus cattle´s growth of 2.1% to the total world milk production.

Dr Marco Zava, a renowned Argentine buffalo expert, raised two issues in his dissertation. The first point is about the comparative advantages and the greater profitability generated by buffalo compared to cattle. The second issue was a scientific explanation of the physiological factors that allow greater productive efficiency of buffalo versus cattle.

The Symposium closed with a unanimous election of Bolivia as the site for the next Symposium in 2025,

as well as a meeting to rally strong regional support for Venezuela as the venue for the upcoming 2023 World Congress of the International Buffalo Federation.

First annual buffalo auction

On Wednesday, November 16, APACRIBU, the Paraguayan Association of Buffalo Breeders, organized the first annual associative auction of buffaloes, auctioning almost 200 animals of various categories. It was a unique moment where one could live the convergence of Paraguayan culture with the musical presentation and typical dance, the tasting of multiple cuts of buffalo meat presented by BBA Master Leyzman Salim, renowned as being one of the best in Latin America; and the party of the buffalo auction.

Tour Bufalero

On November 17 and 18, field trips were held to the Bella Italia ranches in San Miguel, Las Talas in Misiones and Santa Florencia in Caazapá, to verify the tradition, innovation and Paraguayan livestock potential, reflected in each of the selected estancias. This trip to the interior of the country allowed all to visit local ranches and see firsthand the productive capacity of Paraguay, as well as the neatness and innovation in the work of each of its owners.

At *Bella Italia ranch*, we were received by Giambattista Lozzio who has been in bubaline production since 1982 and his legacy continues with his daughter Isabella. The establishment stands out for its 40 years of experience in breeding buffalo and horses. It is renowned for its highly anticipated annual televised horse and buffalo auction.

At the *Las Talas ranch*, we were received by Ismael and Fernando Llano, leaders of a family livestock tradition of more than 100 years, who meticulously orchestrated the reception of the international delegations. The Hacienda Las Talas de Ganadera El Fogón is an emblematic estancia of excellence and innovation in the agricultural sector of Paraguay, where it was possible to feel, not only the strength of local cattle ranching, the promotion of regenerative management within its fields, and lately the inclusion of buffaloes in its livestock herd.

Estancia Santa Florencia, located in Caazapá, 250 km from Asunción, is also a leading establishment in buffalo production in Paraguay. It was Manuel Ferreira Sosa, who in the '50s imported buffaloes from Brazil for Estancia Maria Stella and what is now Santa Florencia. Currently, the family undertakes silvan-pastoral afforestation, regenerative pasture and livestock based on concepts of Holistic Management (Alan Savory).

The buffalo is a key factor in Paraguayan territory

The buffalo species brings the potential for enormous contributions to the ranching industry in Paraguay and the region for its precocity, conversion, profitability, adaptability and longevity. Paraguay has more than 10 million hectares of wetlands (100,000 km^2), considered unsuitable for cattle ranching, where the

buffalo easily adapts due to its hardiness and capability of producing in difficult terrain. There are currently more than 256 buffalo producers and approximately 14,000 animals.
The bubaline sector of Paraguay has received important support from the government, and it can be said that the history of buffalo is changing in Paraguay, and it will be a key factor in the development of a modern and substantial livestock alternative, decisive for the coming years.
During 2022, APACRIBU met its objectives: articulating with the Government the design of public policies, strengthening the Association, bringing awareness of the buffalo´s potential in the country, and promoting Paraguay internationally as an attractive destination to receive foreign investment for the breeding and production of buffalo and derivative products.

The Buffalo Competitiveness Table was first established in the Vice Ministry of Livestock, the X Buffalo Symposium of the Americas and Europe organized by the Paraguayan Association of Buffalo Breeders was successfully developed and declared as an event of national and ministerial interest by the Chamber of Deputies, the National Secretariat of Tourism and the Ministry of Agriculture and Livestock.

Finally, the declaration of institutional interest issued a few days after the Symposium, by the Ministry of Industry and Commerce on the development of the bubaline value chain, marks a very clear past and future of the buffalo sector that aims to become a regional model for its opportunities and competitive advantages offered in the country. This fact made it clear that all the efforts and work time invested in favour of the bubaline development of Paraguay are having positive results.
The recent ministerial resolution emphasizes the capacity of the buffalo to generate sustainable cattle breeding, capable of regenerating natural landscapes and with the potential to use some of 100,000 km^2 of impoverished lowlands in an environmentally friendly manner, without requiring a change of land use. This will be accompanied by the promotion of rational and rotational grazing, promoting regenerative management and afforestation in the fields.

The Declaration of Asunción

Finally, in the framework of the tenth edition of the Buffalo Symposium, "The Declaration of Asunción" was signed. The presidents of the Associations, which bring together thousands of bubaline producers in the Americas, approved this initiative that aims to strengthen collaborative efforts to meet the needs shared by all the member countries of the American Buffalo Federation.

The declaration seeks to unify regional efforts to design and implement public policies; exchange experiences and knowledge; promote the breeding and rearing of buffalo and the production, marketing and export of buffalo derivatives; create information and communication campaigns on the competitive values of the sector; and launch the operation of the digital platform www.bufalodegua.com, designed by the Paraguayan Association of Buffalo Breeders, which aims to integrate all the information, opportunities, regional directory, offers, training and a marketplace, related to the buffalo sector in the American continent.

In Summary

All in all, the X Buffalo Symposium of the Americas was very successful in bringing together our community of buffalo breeders as the first post-pandemic event, exchanging knowledge and experiences, setting an agenda for collaborative work in upcoming years, and well as strengthening the friendship that distinguishes our community through enjoyable and memorable events and exchanges.

Paraguay thanks you for your trust, participation and friendship!

(Visit www.bufalodeagua.com to see presentations, pictures and summary documents of the event)

Richard Moss
President of the Paraguayan Association of Buffalo Breeders

IBF-CREA online course 2022-23

"BUFFALO FARMING ON AIR: FROM FARM TO FORK"
The IBF secretariat together with CREA has decided to organize 2022, a series of six webinars covering the main aspect of the buffalo production chain: milk production process, meat production process, and sustainability.
The two-hour webinars already on air are:

WEB 1. *Buffalo calf management: From birth to weaning*;
WEB 2. *Buffalo heifer & cow management*;
WEB 3. *Reproductive management*;
WEB 4. *From raw milk to dairy products***;**
WEB 5. *Meat production process*

WEB 6. *Buffalo Sustainability* will be on air on February 21st

Information on the webinars is available at www.internationalbuffalofed.org website.

Video recordings of the webinars are available at the International Buffalo Federation YouTube channel: shorturl.at/ikyN2

The world is still facing with Covid-19 pandemic, for this reason the residencial IBF Training courses in Italy are still on hold. The IBF secretariat together with CREA has decided to organize in 2022, a series of six webinars covering the main aspect of buffalo production chain: milk production process, meat production process, and sustainability.

The two-hour webinars will be every one-two month from ebruary on TEAMS platform, starting with the milk production process that will include six webinars:

I. *Buffalo calf management: from birth to weaning;*
II. *Buffalo heifer & cow management;*
III. *Reproductive management;*
IV. *From raw milk to dairy products*
V. *Buffalo for meat production*
VI. *Environment and sustainability of buffalo farming*

For info and registration please send an email to:
internationalbuffalofed@gmail.com, antonella.chiariotti@crea.gov.it

INTERNATIONAL BUFFALO FEDERATION

UPCOMING EVENTS

13th WORLD BUFFALO CONGRESS

Dear colleagues, friends, and Buffalo's family from all over the world,

The rising world population, hyper-urbanization, the unpredictable and changing climate, the global pressures on water and land use, as well as the growing concern about the environmental impact of farming animals, linked to the general question of how to eradicate hunger in the world, converge as a tremendous global social challenge (FAO, 2018). Total world demand for food will increase between 35% and 56% between 2010 and 2050, bringing a global challenge to answer the question of how to produce and supply enough safe, nutritious, and sustainable food to a population expected to increase to 9 billion by 2050 (FAO, 2018).

The water buffalo, an emerging species in the rest of the world apart from India, could contribute to long-term global strategy towards more sustainable food production from ruminants, where human requirements for high nutritional protein quality products such as dairy and meat products are needed. Buffalo farming continues to grow worldwide at a rate higher than other production species (Buffaloes: 16%; Cattle: 12.8%; Sheep: 9.7%; Goats: 2.6%; Pigs: 12.4%) in the same period (FAO, 2015). The current global buffalo population is approximately 204 million heads, accounting for more than 98 per cent located in Asia; 0.8 per cent in Africa, particularly Egypt; 0.9 per cent in South America; and 0.2 per cent in Europe (Minervino et al., 2020; FAO, 2019). The growth rate of buffalo milk (4.1%) exceeded the growth rate of cow's milk (2.1%), indicating a growing interest in buffalo milk, which now contributes 15.2% of total milk production in the world compared to 12.8% obtained in 2010 (The Word Dairy Situation, 2021).

As the buffalo population continues to expand in the world and Latin America, in Venezuela in particular, it is growing at an estimated rate of 15-17% per year (CRIABUFALOS, 2022); despite the national economy, with various challenges over time, allowing the migration of livestock systems towards Buffalo due to better tolerance, ability to face setbacks and better adaptability and performance of this species compared to cattle under adverse conditions, after the vulnerability of the Venezuelan economy in recent years, is the right moment where the nation is in an economic metamorphosis that forces us to demonstrate sustained and sustainable growth in buffalo farming. The current buffalo population in Venezuela is approaching 2.500.000 heads, representing an essential source of animal protein by contributing to nearly 40% of the milk and dairy products and 20% of the meat consumed in the country (CRIABUFALOS, 2022). During the VI World Buffalo Congress held in Venezuela in 2001, the potential that the Venezuelan buffalo family had had before was evident, and the enthusiasm to promote and develop this species has never stopped allowing us to achieve such an increase in the herd population. We expect the participation of FAO in this event to exchange information on world inventories, update it and highlight the importance that the Buffalo represents within our territory.

We have joined efforts from the Venezuelan Buffalo's Breeders Association (CRIABUFALOS), the University of Zulia (LUZ, La Universidad del Zulia), the Ministry of Agriculture and Land, and the Venezuelan Institutes of the Milk (INVELACAR) and Meat (CONVECAR), besides established companies in both the meat and dairy industry, with more than 200 associate members and with the direct participation of the 17 member countries of the American Federation of Buffalo Breeders. This magnificent event will be held in the capital and heart of the country, Caracas, a modern and thriving metropolis with 3.5 million inhabitants and Venezuela's largest conventions and five-star hotel accommodations city, enriched with many restaurants to satisfy all gastronomy tastes, which also concentrates the most significant consumption of products derived from Buffalo farming.

Therefore, we are delighted to invite you to attend the 13th World Buffalo Congress, 2023, to be held in Caracas, Venezuela, during 22-24 November 2023, to contribute and receive all scientific knowledge achieved around the water buffalo with the advances it implies to continue contributing to the world

what this beautiful species has given to our country and simultaneously witness buffalos' farming activities in one of America's most engaged countries with water buffalo production and development. We also encourage you to visit our tropical paradisiac Caribbean and South American land to meet our people and exchange and learn about our culture. We want to host all our guests as they deserve, just as we have been hosted at each congress and symposium on our tour worldwide. Venezuela and the Americas gathered are eager to receive, exchange, and promote knowledge, ideas, advances, and new technologies about water buffalo management, development, production, and industry, implying an incredible milestone for the growth, buildup, and water buffalo impact on our society.

The agenda includes two introductory pre-conference workshops, one on Reproduction and Biotechnology and the other on Buffalo's products and Industry (November 20-21, 2023), the central congress meeting (November 22-24, 2023), simultaneously with scientific poster presentations, areas for commercial stands, and animal exhibitions with the participation of more than 100 elites specimens of high genetic value coming from the leading buffalo farms in the country, followed by the usual Buffalo's Tour (November 25-27, 2023) to those interested in knowing our buffalo production's systems.

Our scientific program encloses a complete plan combining academia, scientific exchange, business and industry arena, and the organization of a Buffalo show, encompassing an entire program combining academia, scientific discussion, business industry arena, and animal exhibition in one place to discuss management and animal welfare, feed and nutrition, one health, genetic, reproduction and biotechnology, Buffalo's products, industry and marketing, digitization and precision technologies, sustainability, and socioeconomics. Finally, with the growing demand for food to meet the needs of the population coupled with the increasing limitations for agriculture in the future, as mentioned above, it is imperative, as well as our commitment to the world, to offer alternatives for sustainable agriculture, which must go hand in hand with a significant increase in production efficiency. Indeed this event will mark a before and after in the history of buffaloes in Venezuela and turn the world's eyes towards this incredible species as an alternative For Carbon-Neutral Footprint Livestock. Sincerely yours, BBA.

Mr Nicola Fabbozzo
President of the IBF
Chair local organizing committee 13th WBC

Prof. Dr. Juan Carlos Gutiérrez
University of Zulia
Chair of the scientific committee 13th WB

11TH ASIAN BUFFALO CONGRESS 2024

The President of the Asian Buffalo Association Prof Omar Md Faruque who will organize the next Asian Buffalo Congress in Bangladesh in 2024, communicated that the executive committee of Bangladesh Buffalo Association has been formed and includes Farmers, Service providers, Researchers and Academics.

The committee will play an effective role in the promotion of buffalo in Bangladesh, will expand networking at a national and international level, and also organize all seminars during the future 2 years including the next Asian Buffalo Congress (ABC2024).

5th IBF TRAINING COURSE ON BUFFALO MANAGEMENT AND INDUSTRY

International Buffalo Federation and CREA - Animal production and Aquaculture of Monterotondo (Rome) are organizing the 5th IBF training course on buffalo management and industry which will take place in Italy on **9-19 May 2023**.

The course will give the participants a general overview of the main Italian industrial, commercial, and research entities. The topics addressed will concern:

- **genetic selection and improvement with new molecular approaches**
- **reproductive biotechnologies**
- **management**
- **health and animal welfare aspects**
- **quality of products (milk and meat) and their industrial transformation**
- **sustainability**

The course will be in English. A maximum of 35 places are available, and a preference will be given according to the registration order.

The fee is 1550 euros for IBF members, and 1600 euros for non-members and includes accommodation, meals and transportation during the course. A pre-registration (500 euros) will be due **before January 31st**.

Info: internationalbuffalofed@gmail.com

May 2023	**Morning**	**Afternoon**
Tuesday 9	Registration	CREA farm and research centre visit (Monterotondo)
Wednesday 10	Lectures at CREA (Monterotondo)	Farm and cheese industry Visit (Monterotondo)
Thursday 11	Italian Breeder Association (AIA)(Roma)	
Friday 12	Bull center (Perugia)	Assisi City tour
Saturday 13	*Campagna Amica Market* (Italian and certified origin agricultural product- Rome)	FREE
Sunday 14	Free or Visit to an archaeological site (on demand)	
Monday 15	Farm and cheese industry Visit (Latina)	
Tuesday 16	Farm and cheese factory Visit (Caserta)	
Wednesday 17	National Buffalo farm (Salerno) and a practical approach to “Pasta filata” cheese production Visit Paestum Temple	
Thursday 18	Farm and cheese factory Visit (Salerno)	ISZM - National Reference Centre for Hygiene and Technologies of Water Buffalo Farming and Productions, (Naples)
Friday 19	Lectures at CNR (Naples)	Closing Ceremony

MEMORIES

Jesus Alberto Reggeti Gomez

Last November 8th Jesús (Chucho) Reggeti passed away in his Terecay Ranch. He has been a pioneer in buffalo breeding in Venezuela, and a great friend, colleague and companion on numerous buffalo trips around the world. He graduated as a Zootechnical Engineer from the University of Gainesville, Florida, USA. Owner of a great culture and a refined sense of humour, he knew how to cultivate friendships with a lot of quality. The Reggeti Gómez are part of the distinguished group of pioneering families of buffalo production in Venezuela. In addition to the Terecay Ranch, located on the left bank of the Apure River, in the south of the State of Guárico, the Reggeti bought the Pamichal Ranch in 1981 (in El Milagro, Táchira State), which would end up serving as a source of radiation for many herds that would be founded in the region. Great professional, very efficient buffalo producer, both for meat and milk and derivatives. Passionate about the species, he was a tireless teacher for the dissemination of knowledge, with training organized in his establishment, with courses and conferences held in various universities and countries. He collaborated for many years with the Argentine Association of Buffalo Breeders (AACB) holding conferences, and courses and acting as a jury in various exhibitions. He was one of the founders of the International Buffalo Federation, and the IBF official representative of Venezuela for many years. In addition, he was, with his family, an incomparable host on the occasion of numerous study trips on the buffalo that we made to Venezuela between 1987 and 2008. In 1978, Chucho, who was recently married, went with his wife Morella to Italy and Bulgaria to train in the buffalo activity. In Bulgaria, they selected about 130 Murrah cross buffaloes to take by plane to Venezuela. He was the President of Asobufalo Venezuela. He has left a buffalo path in Venezuela, in America and in the world.

Marco A. Zava
Member of the Board of Directors and the Technical Committee
of the Argentine Association of Buffalo Breeders

IBF ORGANIZATION

GOVERNING BODY
President: Nicola Fabbozzo (Venezuela), nicolafabbozzo@gmail.com
General Secretary: Antonio Borghese antonio.borghese@email.it
Executive Officer Asia: Inderjeet Singh (India), inderjeet.dr@gmail.com
Executive Officer America: Joao Ghaspar de Almeida (Brazil) joaoghaspar@gmail.com
Executive Officer Europe: Luigi Zicarelli (Italy), zicarell@unina.it;

SECRETARIAT OFFICE

Antonella Chiariotti (Italy) internationalbuffalofed@gmail.com
Vittoria Lucia Barile (Italy) vittorialucia.barile@crea.gov.it
Carlo Boselli (Italy) carlo.boselli@izslt.it
Federico Infascelli (Italy) federico.infascelli@unina.it
Anna Chiacchierini (Italy) centrotori@chiacchierini.it

STANDING COMMITTEE

Argentina	Marina Born Engels mbornengels@gmail.com Marco Zava marcozava@gmail.com Felix Noguera aacbufalos@gmail.com Gustavo Crudeli gacrudeli@hotmail.com; Jose Konrad konradjl@hotmail.com
Australia	Jean-Luc Batchelor jeansandluck@gmail.com
Bangladesh	Lal Teer livestock development limited qmehuque@gmail.com Omar Md Faruque faruque_mdomar@yahoo.com
Bolivia	Carlos Rodrigo Molina Paz gerencia@kdeoro.com Denis Gomez celtanumerouno@gmail.com Duston Larsen Metenbrink duston1@gmail.com Jaime Enrique Rozemman Attie Jaime.Rozenman.Attie@gmail.com Javier Vaca Saucedo javier.vaca@skyquest.com.bo Jose Ernesto Becerra Abularach josesito95@hotmail.com Karlos Rodrigo Suarez Moreno rodrigosuarezmoreno@hotmail.com Luis Cesar Quiles Skork luisskorc@gmail.com Milton Parra Gonzales parra_milton@hotmail.com Robert James Curt Haab Justiniano robert.haab@gmail.com Walter Kuljis Fuchtner walterkuljisf@gmail.com
Brazil	Joao Ghaspar de Almeida, joaoghaspar@gmail.com William G. Vale, wm.vale2011@gmail.com Antonio Humberto H. Minervino, ah.minervino@gmail.com Otavio Bernardes, otavio@ingai.com.br Caio Rossato, michele_minoru@hotmail.com Pietro Baruselli pietro.baruselli@gmail.com
Bulgaria	Tzonka Peeva, tzonkapeeva@abv.bg
Canada	Martin Littkemann, mlittkemann@xplornet.com
China	Liguo Yang, yangliguo2006@qq.com
Colombia	Claudia P. Roldan fortalezacpr@gmail.com

	Alba Lucia Suarez luciasq99@gmail.com Juan G Angel juangangel@gmail.com
Costa Rica	Sady Quesada, squesada63@hotmail.com Alvaro Salas Vega neloreriocuarto@yahoo.com Juan Rafael Salas juanrafaelsalas@gmail.com
Cuba	Alina Mitat, isamani51@gmail.com
Egypt	Sheriff Elshenawy sh.elshenawy@outlook.com
Equador	Lorens Olsen lorens_olsenp@hotmail.com
Germany	Andreas Hoeflich hoeflich@fbn-dummerstorf.de Torsten Hemme Torsten.Hemme@ifcndairy.org
Greece	Dimitrios Roustemis roustemis@mail.com Aristotelis G. Lymberopoulos alymperopoulos@ihu.gr
Guatemala	Oscar Molina oscaremilio2001@gmail.com
Hungary	Hungarian Buffalo Breeding Association egyesulet@magyarbivaly.hu
India	Pawan Singh pawansinghdabas@gmail.com Inderjeet Singh inderjeet.dr@gmail.com Ashok Balhara ashok.balhara@icar.gov.in Ashok Boora ashokcirb@gmail.com Sushil Phulia sphulia@gmail.com Sandip K Khurana sandipkk@yahoo.co.in
Indonesia	Ika Sumantri isumantri@ulm.ac.id Abdullah Akhyar Nasution abdullah.akhyar@unimal.ac.id
Iran	Mahmood Amiri mahmood.amiri225@gmail.com Mohammad Nikookar Dashtmian m.nikookar10@gmail.com Kourosh Elyasi kourosh.elyasi@gmail.com Fatemeh Derisavi derisavifatemeh@gmail.com Parisa Mirzapoor rik kourosh.elyasi@gmail.com
Iraq	Khalid Al-Fartosi khalidalfartosi@yahoo.com Jabbar Alsaedy alsaedyjabbarkh@gmail.com
Italy	Antonio Borghese antonio.borghese@email.it Leopoldo Iannuzzi leopiannuzzi949@gmail.com Angelo Coletta direzione@risbufala.it Vittoria L. Barile vittorialucia.barile@crea.gov.it Carlo Boselli carlo.boselli@izslt.it Nello Giorgi giorgi.nello@libero.it Antonella Chiariotti antonella.chiariotti@crea.gov.it Antonio Perrone info@wedap.eu Massimo De Marchi massimo.demarchi@unipd.it Giovanni Binotti g.binotti58@gmail.com Maria Concetta Campagna mariaconcetta.campagna@izslt.it Angelo Citro vincenzocitro@inwind.it Andrea Rosati rosati@eaap.org Olimpia Barbato olimpia.barbato@unipg.it Federico Infascelli federico.infascelli@unina.it

	Domenico Vecchio domenico.vecchio@izsmportici.it Raffaele Garofalo r.garofalo@fattoriegarofalo.it Anna Chiacchierini centrotori@chiacchierini.it Luigi Zicarelli, zicarell@unina.it ANASB info@anasb.it Esterina De Carlo esterina.decarlo@izsmportici.it
Messico	Diego Armando Morales Canela damoralesc@outlook.com Ismael Coronel carnedebufalo@hotmail.com
Nepal	Binod Gupta binodguptaiaas@gmail.com Nepal Dairy Association nepalnda@gmail.com
Nicaragua	Cesar Leiva cesar.a.leiva@hotmail.com
Pakistan	Ahmad Naseem Goraya drnaseemgoraya@gmail.com Ahsanullah Rai randhairadairy@gmail.com Ali Imran Khan aliimran5555437@gmail.com Arfan Ali Tahir arfanali1@gmail.com Atia Basheer atia.basheer@uvas.edu.pk Hasan Riaz hasan@cuisahiwal.edu.pk Imran Zahoor imran.zahoor@uvas.edu.pk M. Sajjad Khan drsajjad2@yahoo.com Maqsood Aktar drmaqsood66@gmail.com Mian Sami Ullah miansamiullah84@gmail.com Muhammad Ashiq Ch chashiq377@gmail.com Muhammad Awais mavais@uvas.edu.pk Muhammad Farooq alhaiwan@yahoo.com Muhammad Hayat Jaspal hayat.jaspal@uvas.edu.pk Muhammad Junaid mjunaid@uvas.edu.pk Muhammad Naveed ul Haq muhammad.naveed@uvas.edu.pk Muhammad Qamar Shahid qamar.shahid@uvas.edu.pk Nasim Ahmad nasimahmad@uvas.edu.pk Saeed Hassan Mian saeed.hotiana1@gmail.com Sajid Muzaffar Chaudhary sajidmch3@gmail.com Talat Naseer Pasha tnpasha@uvas.edu.pk, drmaqsood66@g,ail.com
Panama	Milena Stacy Bernal mscb_19@hotmail.com Vivian Jimenez Hidalgo viviancita22@hotmail.es
Paraguay	Richard Moss-Ferreira rmossf.adm@gmail.com Guido Paolo Occhipinti ochiguido@gmail.com
Romania	Ioana Nicolae ioana_nicolae2002@yahoo.com Livia Vidu liviavidu@gmail.com
Thailand	Thuchadaporn Chaikhum-Marcou tuchadaporn**@**hotmail.com
Trinidad	Lisa Benjamin lisa_benjamin64@yahoo.com Lillawatti Rastogi leela3053@hotmail.com
Turkey	M. Ihsan Soysal misoysal@gmail.com Ercan Tasleden istanbulmanda@hotmail.com
U.K.	Robert Palmer buffaloUK@aol.com
USA	Thomas Olson tcwb@valornet.com

Nanda Joshi joshin@msu.edu
Shannon Gay Shannonsfieldservice@yahoo.com

Venezuela

Alberto Davila ajdg51@gmail.com
Angelo Pluchino Angelopluchino@hotmail.com
Carlos Garzon cgarzon@elgarzon.com
Carlos Paez carlosepaez2@gmail.com
Carmen Elena Rincon carmenrincon24@gmail.com
Eduardo Tomas eduardotomas85@gmail.com
Francisco Linares bufalinmo@yahoo.com
Gregorio Garzon aerogarzo@hotmail.com
Jairo Fernandez Quijano jairo_fernandez@hotmail.com
Javier Ramon Espinoza javierrespinoza@hotmail.com
Jean Carlos Contreras nellyflorescolcont@hotmail.com
Jesus Bejarano jesus1967b@gmail.com
Jorge Alvarez jorgealvarezpb7@gmail.com
Juan Carlos Bejarano juancbejaranor@gmail.com
Juan Carlos Gutierrez-Anez jcgutv@hotmail.com
Luis Alfredo Pacheco Diaz lpcivia@hotmail.com
Luis Nevett Gimon lnevett@yahoo.com
Luis Perez Stuve luisperezstuve@gmail.com
Maria Angelica Colmenares criabufalos@gmail.com
Marlon Acosta marlonp76@hotmail.com
Mayti Contreras mayticcg17@gmail.com
Nicola Fabbozzo nicolafabbozzo@gmail.com
Nicolas Perez nicolasperezp95@gmail.com
Rafael Emilio Rincon Marquez rafaelemiliorincon@gmail.com
Rosaura Perez Gil rperezgil@gmail.com
Victor Nieves nievesvic24@gmail.com

Vietnam

Su Than Long sulongip@yahoo.com

INTERNATIONAL BUFFALO FEDERATION

International Buffalo Federation
c/o CREA

via Salaria 31
00015 Monterotondo
Italy

www.internationalbuffalofed.org
FACEBOOK: shorturl.at/kvFL7
YOUTUBE: shorturl.at/ikyN2