Reproductive management of buffalo (Bubalus bubalis) in Italy

Manejo reprodutivo da búfala (Bubalus bubalis) na Itália

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Abstract

Livestock products in tropical areas play a crucial role, which extends beyond their traditional supply of meat and milk. Unprecedented economic growth in developing countries, accompanied by the increases in income and purchasing power and by changes in food preferences, together with the growth of human population, has increased demands on the livestock sector. Livestock products, such as milk and meat, have undergone great modification in response to these recent developments. In Italy, buffalo population has grown from 12 thousand heads in 1947 to 397 thousand in 2017. On the national territory there are 2212 farms concentrated for 74% in the Campania Region, which allow Italy to position itself in the 7th place for the production of fresh buffalo milk in the world, generating an economic induced linked to the Mozzarella di Bufala Campana DOP of 721 million euros for consumption. The Italian Mediterranean buffalo has undergone selection for efficiency of production in intensive dairy systems that aim to achieve milk production throughout the year. Continuous production of buffalo milk is required to meet the market demand for mozzarella cheese and other dairy food products derived from buffalo milk. In the Mediterranean region, female buffaloes show annual fluctuations in reproduction with distinct breeding and nonbreeding seasons. The decline in fertility during the transition from the breeding to nonbreeding seasons is associated with a greater incidence of anestrus, a decline in the function of the CL, and an increase in embryonic mortality Season affects oocyte developmental competence in buffalo, as indicated by higher cleavage and embryo yields recorded in autumn compared to spring, with intermediate results observed in summer and winter. The seasonal characteristic of this species, causes an increase in the phenomenon of embryonic mortality during the periods characterized by increasing daylight length. . In the farms that carry out TAI, absolute or associated with natural mated technique, different plans are used, based on the specific market needs of each farm, on the structures, the management and the reproductive season, preferring protocols such as ovsynch during the period of decreasing daylight length and protocols supported by progesterone during periods of anoestrous. The results obtained in the development and application of the most innovative techniques in the buffalo breeding sector, in synergy with the efficiency of the veterinary information systems, make of Italy a nation at the forefront in the international scene in the breeding techniques and health problems of the buffalo, to which many countries look as a model.

Keywords*: Buffalo, Reproduction, IATF, Embryo Mortality.*

Introduction

Livestock products in tropical areas play a crucial role, which extends beyond their traditional supply of meat and milk. Unprecedented economic growth in developing countries, accompanied by the increases in income and purchasing power and by changes in food preferences, together with the growth of human population, has increased demands on the livestock sector. Livestock products, such as milk and meat, have undergone great modification in response to these recent developments.

The buffalo is considered a triple-purpose animal, providing milk, meat and draught, though milk is the main product, followed by meat. However, it is worth pointing out that the swamp type of buffalo is used for work in Southeast Asia and China, and it often represents the mainstay of the rural economy of small farmers in many developing countries, as well as becoming an important source of meat and milk. When buffaloes are compared with other animals, they are more adaptable and show many homeo-kinetic mechanisms to maintain critical body functions. This condition, which is obtained at the expense of changes in other physiological functions, allows them to represent an economic and valuable species in rush areas of tropical countries. The water buffalo is a domestic species raised in many different parts of the world. Its importance for the wealth and welfare of the human population has been recognized in recent years.

The world buffalo (bubalus bubalis) population has been estimated at over 199 million head in 2016 (http://www.fao.org/faostat/en/#data/QA) in more than 46 countries. World's Buffalo population has had an increase of 22%, from 164 million heads in 2000 to 199 million heads in 2016. Buffalo world's milk production has been estimated in 111 million of tons in 2016, an increase of 15% compared to 2011 (ww.fao.org/faostat/en/#data/QL).

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Recebido: 19 de setembro de 2018
Aceito: 18 de janeiro de 2019

Countries in which the buffalo has the highest presence of animals are represented by developing countries such as India (56.37%), China (23.88%), Pakistan (18.37%), Nepal (2.59 %), Egypt (1.85%), Myanmar (1.83%), the Philippines (1.44%) and in which the type of farms is predominantly family and extensive.

Italian reproductive buffalo management in a typical farm

In Italy, buffalo population has grown from 12 thousand heads in 1947 to 397 thousand in 2017. On the national territory there are 2212 farms concentrated for 74% in the Campania Region, which allow Italy to position itself in the 7th place for the production of fresh buffalo milk in the world, generating an economic induced linked to the Mozzarella di Bufala Campana DOP of 721 million euros for consumption (ISMEA, Qualivita, 2018).

The Italian Mediterranean buffalo has undergone selection for efficiency of production in intensive dairy systems that aim to achieve milk production throughout the year (Zicarelli 2001; Di Francesco et al., 2012). Continuous production of buffalo milk is required to meet the market demand for mozzarella cheese and other dairy food products derived from buffalo milk (Campanile et al., 2013). In the Mediterranean region, female buffaloes show annual fluctuations in reproduction with distinct breeding and nonbreeding seasons (Campanile et al., 2010). As buffaloes are short-day breeders, the annual peak in fertility coincides with decreasing day length from autumn to winter (Zicareli, 2007). From winter to spring, females transition to the nonbreeding season in response to increasing day lengths (Zicarelli 1997). The decline in fertility during the transition from the breeding to nonbreeding seasons is associated with a greater incidence of anestrus (Campanile et al., 2010), a decline in the function of the CL (Vecchio et al 2012), and an increase in embryonic mortality (Campanile et al., 2007; Campanile et al. 2008a: Campanile et al. 2008b) Season affects oocyte developmental competence in buffalo, as indicated by higher cleavage and embryo yields recorded in autumn compared to spring, with intermediate results observed in summer and winter (Di Francesco et al. 2012). Natural mating is often preferred to assisted reproduction (estrus synchronization and AI) during the transition phase, and the nonbreeding season as assisted reproduction is thought to be less effective during the seasonal decline in fertility (Zicarelli et al., 1997b; Vecchio et al., 2007). The efficiency of AI has doubled (25%–50% pregnancy rate) over a period of approximately 20 years (Zicarelli et al., 1997a; Campanile et al., 2011), and the most successful protocols involve the synchronization of ovulation and timed artificial insemination (TAI) (Neglia et al., 2008; Vecchio et al., 2013; Carvalho et al., 2013) However, even with this protocol, Italian buffaloes would appear to show a decline in pregnancies during the transition to the nonbreeding season that is likely due to a decrease in activity of the CL and increase in the embryonic mortality that were noted above (Russo et al., 2010). Differences in the proteomic profiles of normal chorioamnions and retarded chorioamnions in buffalo and also differences in the adjacent uterine normal caruncles and retarded caruncles has been revealed by Balestrieri et al., 2013, a particularly notable difference between normal and retarded chorioamnions was the reduced expression in retarded chorioamnions of proteins associated with protection from oxidative stress. Normal and retarded caruncles showed differences in protein expression associated with immunological mechanisms and vascularization.

In buffalo species embryonic mortality is considered one of the major causes of poor fertility, especially in the animals inseminated during the period characterized by increasing daylight length. In fact, in Italy, as specified above, the application of the out of breeding season mating technique (Zicarelli, 1997) guarantees milk production in accordance with market requirements, but it forces the breeders to mate buffaloes during the less favourable periods. Embryonic mortality in buffalo species may occur in different stages of pregnancy and it may be due to several causes. On the basis of the last studies, the windows for embryonic mortality in buffaloes can be divided (Campanile et al., 2010) in:

a) early embryonic mortality (EEM), which occurs between Day 15 to Day 24 of pregnancy and incises for around 20%;
b) late embryonic mortality (LEM), between Day 25 and Day 45, which is described in around 40% of pregnant animals at day 25 post-fertilization;
c) foetal mortality (FM), which is observed in 10% of animals and occurs between Day 46 and Day 90 of gestation.

These phenomena largely affect reproductive performance in buffalo species, reducing the fertility, especially those submitted to AI. In fact, it can be hypothesized that oocyte fertilization occurs in around 80% of inseminated buffaloes, but only 35-40% of them lead to full term gestation, for the occurrence of pregnancy losses throughout the phases described above.

The seasonal characteristic of this species, causes an increase in the phenomenon of embryonic mortality during the periods characterized by increasing daylight length. It has been observed that embryonic loss in animals mated by AI is 20-40% during seasons characterized by high number of light hours (Campanile et al., 2005; Campanile et al., 2007), whereas values of around 7-10% or 20% are recorded during decreasing light days (Baruselli et al., 1997 Vecchio et al., 2010) or close to the equator (Vale et al., 1989), respectively.

The high variability in terms of embryonic mortality may be probably due to the different distance from the equator, which influences daylight length throughout the seasons. Furthermore, it is worth pointing out that other

causes may be accounted for embryonic mortality. The phenomenon is not always correlated with the breeding season, but with the ovarian resumption after calving and farm reproductive management, embryonic epigenetic expression, environmental conditions (hot, cold, etc.), nutrition, specific and non-specific pathologies, and, obviously, uterine environment (Zicarelli, 2007; Campanile et al., 2009). In fact, embryo survival depends on the physiological regulation of oviductal and uterine function, due to intrinsic errors in maternal physiology or to specific environmental stresses imposed on the mother.

Data from the Ministry of Agriculture, carried out with the support of the Lazzaro Spallanzani Institute for the official control of semen, have shown that the number of buffalo palettes produced in Italy in 2016 was 104,768 (Istituto Lazzaro Spallanzani, 2016).

Another interesting data shows that since 2009, the year of the start of trading of the buffalo sexed semen to 2016, 20.219 palettes of buffalo sexed semen were distributed in Italy, and as shown in several studies (Campanile et al., 2011; Campanile et al., 2013) maintains the same efficiency as conventional semen, while reducing part of the problem of unwanted animals. Now the semen of 51 Mediterranean Italian buffalo bulls is present on the market.

In a recent study conducted by National Reference Centre on Water Buffalo Farming and Productions Hygiene and Technologies Istituto Zooprofilattico Sperimentale del Mezzogiorno-Unit Salerno in a Program for the biosafety of buffalo farms, 348 buffalo farms of the province of Caserta were taken as samples for a total of 119.068 heads. The sample represents 16% of the farms present in Italy and about 30% of the Italian buffalo heritage. The results that emerge (data unpublished) are that in 46% of naturalized mated companies, in 53% both TAI and Naturally mated are used and only 1% of companies are fertilized only for TAI. In the farms that carry out TAI, absolute or associated with natural mated technique, different plans are used, based on the specific market needs of each farm, on the structures, the management and the reproductive season, preferring protocols such as ovsynch during the period of decreasing daylight length and protocols supported by progesterone during periods of anoestrous (Vecchio et al., 2013; Carvalho et al., 2013; Monteiro et al., 2016). An example is that reported in Rossi et al., 2014 These studies were the first comprehensive, multiyear assessment of synchronization of ovulation and TAI in Italian buffaloes. The study was conducted from 2010 to 2012, which allowed the comparison of the responses to synchronization and TAI across years and between seasons within years. In summary, the study has shown that synchronization of ovulation and TAI is an efficient assisted breeding strategy for the Italian buffalo. However, there is a marked seasonal variation in the response of Italian buffaloes to synchronization and TAI, which is related to the seasonal nature of reproduction in Italian buffaloes.

The results obtained in the development and application of the most innovative techniques in the buffalo breeding sector, in synergy with the efficiency of the veterinary information systems, make of Italy a nation at the forefront in the international scene in the breeding techniques and health problems of the buffalo, to which many countries look as a model.

Reference

Balestrieri ML, Gasparrini B, Neglia G, Vecchio D, Strazzullo M, Giovane A, Servillo L, Zicarelli L, D'Occhio MJ, Campanile G. Proteomic profiles of the embryonic chorioamnion and uterine caruncles in buffaloes (Bubalus bubalis) with normal and retarded embryonic development. Biol Reprod, v.88, p.119, 2013.

Baruselli PS, Visintin JA, Barnabe VH, Barnabe RC, Amaral R, Souza AC. Earlypregnancy ultrasonography and embryonic mortality occurrence in buffalo. In: Prooceding V World Buffalo Congress, Caserta, Italy, October, p.776-778, 1997.

Campanile G, Neglia G, Gasparrini B, Galiero G, Prandi A, Di Palo R, D'Occhio MJ, Zicarelli L. Embryonic mortality in buffaloes synchronized and mated by AI during the seasonal decline in reproductive function. Theriogenology, v.63, p.2334-2340, 2005.

Campanile G, Di Palo R, Neglia G, Vecchio D, Gasparrini B, Prandi A, Galiero G, D'Occhio MJ. Corpus luteum function and embryonic mortality in buffaloes treated with a GnRH agonist, hCG and progesterone. Theriogenology, v.67, p.1393-1398, 2007.

Campanile G, Vecchio D, Di Palo R, Neglia G, Gasparrini B, Prandi A, Zicarelli L, D'Occhio MJ. Delayed treatment with GnRH agonist, hCG and progesterone and reduced embryonic mortality in buffaloes. Theriogenology; v.70, p.1544-1549, 2008a.

Campanile G, Vecchio D, Neglia G, Di Palo R, Prandi A, D'Occhio MJ. Progesterone and pregnancy status in buffaloes treated with a GnRH agonist. Livestock Sci, v.115, p.242-248, 2008b.

Campanile G, Neglia G, Vecchio D, Russo M, Zicarelli L. Pregnancy in buffalo cows. In: O'Leary M, Arnett J, editors. Pregnancy protein research. New York: Nova Science Publishers Inc, p.31-91, 2009.

-Campanile G, Baruselli PS, Neglia G, Vecchio D, Gasparrini B, Gimenes LU, Zicarelli L, D'Occhio MJ. Ovarian function in the buffalo and implications for embryo development and assisted reproduction. Anim Reprod Sci, v.121, p.1-11, 2010.

Campanile G, Gasparrini B, Vecchio D, Neglia G, Senatore EM, Bella A, Presicce GA, Zicarelli L. Pregnancy rates following AI with sexed semen in Mediterranean Italian buffalo heifers (Bubalus bubalis). Theriogenology, v.76, p.500-506, 2011.

Campanile G, Vecchio D, Neglia G, Bella A, Prandi A, Senatore EM, Gasparrini B, Presicce GA. Effect of

season, late embryonic mortality and progesterone production on pregnancy rates in pluriparous buffaloes (Bubalus bubalis) after artificial insemination with sexed semen. Theriogenology, v.79, p.653-659, 2013.

Carvalho NA, Soares JG, Porto Filho RM, Gimenes LU, Souza DC, Nichi M, Sales JS, Baruselli PS. Equine chorionic gonadotropin improves the efficacy of a timed artificial insemination protocol in buffalo during the nonbreeding season. Theriogenology , v.79, p.423-428, 2013.

Di Francesco S, Neglia G, Vecchio D, Rossi P, Russo M, Zicarelli L, D'Occhio MJ, Campanile G. Influence of season on corpus luteum structure and function and AI outcome in the Italian Mediterranean buffalo (Bubalus bubalis). Theriogenology, v.78, p.1839-1845, 2012.

Monteiro BM, de Souza DC, Vasconcellos GS, Corrêa TB, Vecchio D, de Sá Filho MF, de Carvalho NA, Baruselli PS. Ovarian responses of dairy buffalo cows to timed artificial insemination protocol, using new or used progesterone devices, during the breeding season (autumn-winter). Anim Sci J, v.87, p.13-20, 2016.

Neglia G, Natale A, Esposito G, Salzillo F, Adinolfi L, Campanile G, Francillo M, Zicarelli L. Effect of prostaglandin F2a at the time of AI on progesterone levels and pregnancy rate in synchronized Italian Mediterranean buffaloes. Theriogenology, v.69, p.953-960, 2008.

Rossi P, Vecchio D, Neglia G, Di Palo R, Gasparrini B, D'Occhio MJ, Campanile G. Seasonal fluctuations in the response of Italian Mediterranean buffaloes to synchronization of ovulation and timed artificial insemination. Theriogenology, v.82, p.132-137, 2014.

Russo M, Vecchio D, Neglia G, Pacelli C, Prandi A, Gasparrini B, Zicarelli L, D'Occhio MJ, Campanile G. Corpus luteum function and pregnancy outcome in buffaloes during the transition period from breeding to non-breeding season. Reprod Dom Anim ,v.45, p.988-991, 2010.

Vale WG, Ohashi OM, Sousa JS, Ribeiro HFL, Silva AOA, Nanba SY. Morte embrionaria e fetale m bufalos, bubalus Bubalis. Lin. Rev Bras Reprod Anim, v.13, p.157-165, 1989.

Vecchio D, Di Palo R, Zicarelli L, Grassi C, Cammarano A, D'Occhio MJ, Campanile G. Embryonic mortality in buffalo naturally mated. Ital J Anim Sci, v.6(Suppl 2), p.677-679, 2007.

Vecchio D, Neglia G, Di Palo R, Prandi A, Gasparrini B, Balestrieri A, D'Occhio MJ, Zicarelli L, Campanile G. Is a delayed treatment with GnRH, HCG or progesterone beneficial for reducing embryonic mortality in buffaloes? Reprod Domest Anim, v.45, p.614-618, 2010.

Vecchio D, Neglia G, Gasparrini B, Russo M, Pacelli C, Prandi A, D'Occhio MJ, Campanile G. Corpus luteum development and function and relationship to pregnancy during the breeding season in the Mediterranean buffalo. Theriogenology, v.77, p.1811-1815, 2012.

Vecchio D, Rossi P, Neglia G, Longobardi V, Salzano A, Bifulco G, Campanile G. Comparison of two synchronization protocols for timed artificial insemination in acyclic Italian Mediterranean buffalo cows out of the breeding season. Buffalo Bull, v.32, p.479, 2013. (Resumo).

Zicarelli L, De Filippo C, Francillo M, Pacelli C, Villa E. Influence of insemination technique and ovulation time on fertility percentage in synchronized buffaloes. In: World Buffalo Congress, 5., 1997, Caserta. Proceedings... Caserta: [s.n.], p.732-737, 1997a.

Zicarelli L, Esposito L, Campanile G, Di Palo R, Armstrong DT. Effect of using vasectomized bulls in artificial insemination practice on the reproductive efficiency of Italian buffalo cows. Anim Reprod Sci, v.47, p.171-180, 1997b.

Zicarelli L. Reproductive seasonality in buffalo. In: Proceedings of Third International Course of Biotechnology in Buffalo Reproduction, Napoli 6-10 October, Suppl. Bubalus Bubalis, 4, pp.29-52, 1997.

Zicarelli L. Buffalo milk production world-wide. In Proceedings of the 6th World Buffalo Congress, 20-23 May 2001, Maracaibo, Zulia, Venezuela'. N. Huerta-Leidenz, J. Vergara-Lopez and A. Rodas-Gonzales (Eds). pp.202-230, 2001.

Zicarelli L. Can we consider buffalo a non precocious and hypofertile species? Ital J Anim Sci, v.6, p.143-154, 2007.