A case study on the effect of farm-design variables and season on incidence rate of some reproductive affections in buffalo

Tulip, A.A. and Metawea, Y.F.A
Animal, Poultry and Environmental Hygiene
Fac. of Vet. Med.; Benha University (Moshtohor)

ABSTRACT

This study aimed to define some of the possible causes of increased incidence rate of some reproductive affections during summer in a herd of buffalo-cows raised under intensive system of production (63.15%, 4.21%, 1.98% and 18.74 for anestrous, vaginal prolapse, uterine prolapse and retained placenta respectively). The study was conducted at three levels: animal inspection, farm and record inspection. Hypocalcemia and nutritional deficiency were excluded as possible contributors to the affections in this case, on the other hand faults in the design of the yards e.g. inability of the animals to make full use for the resting area under the shed due to uneven surface and presence of some concrete projections, insufficient space per animal at the un-shaded drinking troughs and the sandy floor of the yard were all considered as factors interfere with the animals ability to cope with the increased temperature and solar radiation and also reduced the animals chance to alleviate the heat stress extended from June till October as indicated by the temperature-humidity index (THI), which showed levels over 72 during this period of the year. The study sheds the light on the importance of record keeping including the performance of the bull in respect to libido and fertility, and also stressed on the importance of considering the susceptibility of the buffalo to heat stress and provide suitable modification on the design to help animal to alleviate heat stress during hot months.

INTRODUCTION

The domestic buffalo occupies an important niche in many ecologically disadvantaged agricultural systems *(1)*. They play an important role in maintaining a sustainable food production system in developing countries *(2,3)*. Although buffalo husbandry has long been considered characteristic for agricultural areas with extensive rearing systems *(4)*, less is known about the effect of stress on their performance and well being *(5,6)* especially that associated with modern intensive farming. Despite of the good reputation of buffalo cows in adaptation to harsh environment, they have a poor reproductive performance *(7)*. Prolapses, in addition to infectious diseases and mastitis are important health variables relevant to buffalo welfare[4].

In the meantime other researchers attributed the reduced productivity of buffalo to poor management of health and nutrition *(8,9)*. Although design variables are good indicators for animal welfare, other animal measures should be considered to reflect the interaction between the animal and its environment *(10)*. It is now well known that reproductive affections of economic importance are mostly due to many interrelated factors *(11-14)*.

This study was aimed to shed the light on the interactive effect of some design variables and seasonal heat stress on some important reproductive affections in buffalo-cows raised under intensive system of production.

MATERIALS AND METHODS

Problem description

A dairy farm (intensive system for production of buffalo milk) had a problem of high incidence of reproductive affections during the summer calving season. The affections included anestrous, vaginal and uterine prolapse, which mainly occur in pregnant heifers within few hours of their first calving, in addition to other cases of retained fetal membranes. The owner was searching for

possible causes and suggestions for corrective measures.

Topographical examination of the farm

The farm located in El-Max (Alexandria province). The farm exists at latitude 31° 09` 30`` N and 29° 51` 12`` E. It is an intensive farm for commercial milk production. Buffalo-cows were housed under shelters in sandy open yards each of 52 m× 18 m to host 50- 65 cows according to their stage of pregnancy. Hanged shelters (46 m long and 7.5 m wide, oriented in a north-south position) cover the resting area and most of the feeding area. Each yard is equipped with 2 opened drinking troughs each of 4.5 m long, 0.65 m wide and 0.75 m high. Yards are also provided with feed bunks of 47 m long, 0.9 m wide, 0.4 m high from the front and 0.6 m from the back. A bull was left in the yard of the non-pregnant cows, while pregnant cows were separated during the last 3 weeks of pregnancy in calving pens. After calving the newly born calf, immediately separated from its dam, and artificial rearing is practiced.

All cows were mechanically milked 2 times daily in a 16-point herringbone milking parlor. Three weeks before calving (transition period) and one month after calving cows were offered a free access (ad libitum) to their pre-partum balanced ration, then they moved back to the open yard with the bull to receive their regular ration. After confirmed pregnancy, cows moved to another yard with pregnant milking cows. The regular milking ration was formulated to meet the requirement of the dairy herd *(18)*. The ration consisted of 30 kg berseem/head/day (when berseem is not available, dreese was used as 1kg for each 8 kg of berseem), 5 kg concentrate/head/day and 3 kg tibn/head/day.

The ration was presented during the first year (2005- 2006) as the assigned amount of dreese (or green fodder) on the top of which the concentrates were scattered (the whole amount was served on 6 equal portions 6 times daily), while tibn was served between meals. During the second year the ration was served as a total mixed ration (TMR) of green fodder and concentrates.

Data about average temperature and humidity were obtained from the geometric measures department, Navy forces- Armed forces, for the period of the study, data were used for calculation of temperature- humidity index*(19)*, according to the following formula:

THI= T – (0.55- 0.55 RH) (T- 58) where:

THI= Temperature-humidity index.

T= Temperature in Fahrenheit.

RH= Relative humidity.

Animals' inspection

All animals in the herd were generally in good health and body condition; animals with low body condition were separated to receive special care and attention until efficient body condition was achieved. Body condition of the animals was monitored during breeding, drying, calving and post calving periods. Non-pregnant cows were separated in a yard with a fertile bull. Cows were rectally palpated every two months for pregnancy diagnosis.

All cases of vaginal and uterine prolapses were surgically treated and supplemented with intrauterine terramycin tablets, AD_3E® injection and intravenous Cal-D- Mag®. Retained fetal membranes were manually removed, affected cases received massive antibiotic course. All affected cows were dried off after colostral manual collection.

Cases of anestrous were examined for smooth inactive ovary, persistent corpus luteum and pyometra; Medical treatment was provided when necessary, otherwise cows remained in the open yard with the fertile bull.

Blood samples were collected from the new cases of prolapse (vaginal and uterine), and also from cases suffered from retained fetal membranes, to estimate their blood calcium, phosphorus and magnesium levels. Samples from affected cows were compared with the average level of a control group (5

randomly chosen, apparently healthy cows, with normal calvings during the same period). Blood samples were collected from the jugular vein in heparinized plastic tubes and plasma was separated for calcium, phosphorus and magnesium level detection using commercial diagnostic kits *(15-17)* respectively.

Retrospective study of the data

Data inspection covered the period from June 2005, in which the farm had a total number of 165 heads, up to June 2007, in which the farm reached a total number of 400 heads including the followers. The entire herd was purchased from the same place as pregnant heifers (last pregnancy trimester). No information was available for the percentage of reproductive affections in the farm from which the heifers were purchased, but it is worth mentioned that the pregnant heifers were purchased from El-fayoum, which has a different physiogeographic characteristics from Alexandria in which the new farm was established. The pregnant heifers had to cut a distance of about 300 km during transportation, they were transported during May- June , either at the early morning or at night (5 a.m. or 9 p.m.), in groups each of 28 heifers, in 18 m long opened truck. Purchased heifers were apparently healthy and in a good body condition.

A retrospective study for the data collected during the period from June 2005 to June 2007 was conducted. The study focused on the reproductive affections of concern. According to the reported data, fetal membranes were considered retained if they had not been expelled within 12 hours or more after calving *(20)*. Vaginal prolapse cases at different degrees were all reported as prolapse, starting from degree 1 in which only a part of vaginal prolapse appeared in a lying buffalos, and ending with degree 4 in which the whole vagina was prolapsed through vulvar lips in standing position with a continuous straining of the animal, inflammation, injures, edema and cyanosis. Uterine prolapse was defined as the prolapse of the whole uterus outside the vulvar lips. Cows were reported as anestrous if no pregnancy was confirmed for at least 5 months after calving. Data of vaginal and uterine prolapses and retained placenta were reported as number of cases during the season, and as an incidence percent in total number of calvings during the same period. Milk production data were also reviewed for the same period. Average milk-production per season and per head per season was reported. Monthly and seasonal calving percents were calculated as the number of calvings divided by the total number of calvings per year multiplied by 100.

RESULTS AND DISCUSSION

It is worth to make a note that animals in this farm had a good veterinary care in terms of medical, surgical treatments and vaccination protocols. Plasma levels of Ca, Ph and Mg for the affected cases were not statistically different from those of the control group (table 1). Many researchers *(21,22,23)* have attributed the post-partum reproductive affections, including cases of prolapse and retained fetal membranes to hypocalcemia, but the reported values for the affected cows in this study were not statistically different from normal ones, they were within the range values reported by previous researchers for normal buffaloes *(24,25)*. This will eliminate hypocalcemia as a possible cause for the current cases of reproductive affections and hence other environmental or interrelated factors could be involved as suggested by many other researchers *(12,26,27)*.

Data about feeding management, feed constituents along with the recorded results of periodic ration analysis assure that buffalo cows were supplied by their requirements for dairy cows *(18)*. Using of the TMR and reduced time between feedings, in addition to the suitable space area on the feed bunk, regular sweeping-up of the feed and efficient cleaning of the feed bunk are recommended measures for efficient feeding of dairy herds *(28,29)*. All these measures were generally adopted in the farm which was reflected on the general health status and body condition.

Table 1. Blood values of Calcium, Magnesium and Phosphorus in affected and normal buffalo cows.

Parameter (mg/dl)		Affected buffalo cows		Normal buffalo cows
		Retained fetal membranes	*Prolapse	
Calcium	Range	6.97 - 8.25	7.73 - 9.10	7.87 - 9.20
	Mean± SE	7.52 ± 0.25	8.49 ± 0.26	8.49 ± 0.22
Magnesium	Range	2.11 - 3.10	1.91 - 3.20	2.17 - 3.12
	Mean± SE	2.56 ± 0.19	2.57 ± 0.24	2.62 ± 0.18
Phosphorus	Range	4.71 - 6.50	5.15 - 6.91	5.09 - 6.12
	Mean± SE	5.60 ± 0.31	5.94 ± 0.33	5.66 ± 0.17

* Vaginal and/or uterine prolapse.

Table 2. Components of the concentrates.

Physical	% of DM
Yellow Corn	35
Cotton seed meal	30
Bran	17
Dreese	5
Venass	5
Soybean meal	3
Limestone	2.5
Sod. chloride	1
Calcium dibasic-phosphate	0.5
Sod. bicarb.	0.5
Mineral mix	0.5

The flying herd strategy of this farm, as a step for establishing a nucleus herd, made dealing with the data a very difficult task; it also interfered with assessing other risk factors associated with the reproductive affections.

Efficient management structure of a dairy farm should be based on three activities: planning, operational management and overall assessment *(30)*, essential data for individual cows in this farm were also lacking, which points to a weak system for recording data. Record keeping is a corner stone in monitoring herd health; it adds to or detracts from the ability of decision maker to make sound interpretations and decisions *(31)*.

Analysis of data (table 3) revealed that the overall incidence of anestrous in the farm was 41.66%, which is not unusual for buffalo as it agrees with the figures reported by other researchers*(32,33)*. Data from Egypt, India and Pakistan indicate that only 34- 49% of buffalos show estrus 90 days after calving and 31- 42% remain anestrous for more than 150 days *(34)*; In the meantime other researchers pointed to the influence of season on the post partum anestrous length of the buffalo-cow (185.95 days in summer *vs.* 48.42 days in autumn) *(35)*, which is consistent with our findings that the problem of anestrous was more obvious during summer and autumn seasons, compared to the cooler seasons. On the other hand, other studies *(36,37)* stated that a herd of buffalo has almost equal incidences of ovulation in hot and cold seasons, but observed estrus are more frequent and stronger in the cooler season. Farm inspection showed that non-pregnant cows were constantly exposed to a fertile bull, which is a recommended measure to enhance post partum ovulation, conception and calving rate*(38)*, this practice provide an evidence that in this herd the recorded cases of anestrous were true rather than sub-estrous. Meanwhile, sub fertility and reduced libido of the buffalo-bull during summer are well documented*(39)* and should not be overlooked as a possible contributor to the reduced conception and delayed pregnancy in this farm. Unfortunately the farm had no data for periodic assessment of libido or fertility of the bull as it is well known that approaching the buffalo bull is hazardous and proper security and safety measures should be considered, which made periodic collection of semen sample for examination unpractical for them.

Table 3. Incidence of various reproductive affections in the buffalo herd during different seasons.

Season	Reproductive affection	Number of cases	Incidence %
Winter	Anestrous	38	27.53
	Vaginal prolapse	01	00.86
	Uterine prolapse	00	00.00
	Retained placenta	04	03.45
Spring	Anestrous	13	11.71
	Vaginal prolapse	01	01.33
	Uterine prolapse	01	01.33
	Retained placenta	06	08.00
Summer	Anestrous	72	63.15
	Vaginal prolapse	20	04.21
	Uterine prolapse	09	01.89
	Retained placenta	89	18.74
Autumn	Anestrous	57	48.71
	Vaginal prolapse	07	01.85
	Uterine prolapse	02	00.53
	Retained placenta	13	03.43
overall	Anestrous	180	41.66
	Vaginal prolapse	29	02.78
	Uterine prolapse	12	01.15
	Retained placenta	112	10.72

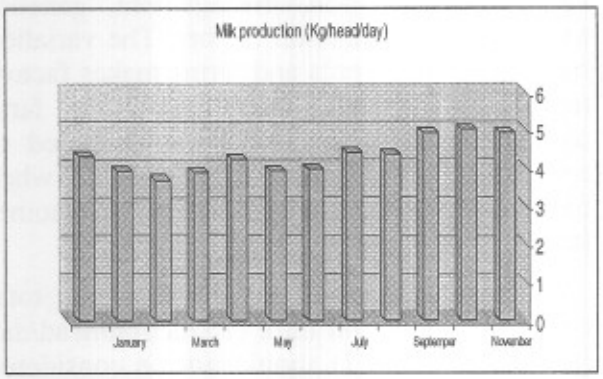
From the same table, it is clear that all the studied reproductive disorders had higher incidence rate at summer compared to cooler seasons, which is in accordance with other researchers ***(12,40)***, who stated that about three quarters of the vaginal prolapse cases in buffalo occurrs between June and October. On the other hand, others reported that dairy cows have higher incidence of uterine prolapse during fall and winter ***(26)***, while other researchers reported no significant effect for calving season on incidence rate of retained placenta in dairy herds ***(13)***. An interactive effect for season and parity on retained placenta was reported ***(41)***, as higher incidence of retained placenta was reported during the warm season for the first lactation and during the cold season for the second lactation. This controversy could be explained on the light of the interactive effect of other factors including age, parity, nutrition, management, genetics and other environmental factors. The variation among different herds and farms makes factors responsible for the problem in one farm unique, hence it is highly recommended to consider these factors with caution when dealing with the same problem in another farm.

The increased calving percent, total milk production and milk production/head/day (table 4 and Fig. 1) should not be considered contradictory to the previous data of increased summer anestrous and reproductive affections (table 3). This improvement in productive performance was mainly due to the farm strategy of introducing new pregnant heifers at late spring and early summer, previous studies on Mediterranean buffalo cows ***(42,43)*** proved that calving occurs mainly between July and December with the highest calving frequency in August-September, they also stated that the inter-calving interval is longer for deliveries occurring between February and June resulting in decreased conception rate during spring and summer seasons; Climate and particularly photoperiod, depending on melatonin secretion play a pivotal role in the reproductive seasonality of buffalo ***(44,45,46)***. The high total milk production and average production/ head/day and the peak milk yield during the hot season is in a complete agreement with previous observations ***(47)*** as the increased calving percent and number of calvings during the late summer and early autumn were reflected on the peak milk yield at early and mid autumn.

Table 4. Average seasonal milk production and calving percent for the buffalo herd.

Season	Total milk production (Ton)	Average production (kg/ head/day)	Calving %
Winter	20.137	4.00	17.11
Spring	24.785	4.03	10.05
Summer	34.872	4.27	24.59
Autumn	55.594	4.99	48.24

Figure 1. Average monthly milk production (Kg/Head/Day) for the buffalo herd.



Weather data Table (5) revealed that THI had values of 72 and above for 5 months a year. THI is an index of potential heat stress conditions for ruminants *(48)*; The critical THI for dairy cows is 72 *(19)*. Other researchers stated that the upper critical temperature for dairy cattle can be as low as 24- 27 °C *(49)*, thus they suffer the consequences of heat stress in a variety of climates. Although most farmers think that buffaloes can tolerate heat better than cattle, in fact buffaloes are more sensitive than cattle to direct solar radiation and temperature *(50)*. Farm inspection revealed that shelters cover more than one third of the total area of the yard, they provide more shade per animal compared to the recommended area (4.6 m^2) per cow *(29)*, but the resting area under the shelter was not efficiently used by the animals due to presence of uneven and ill maintained concrete projections. Hot weather without possibility of bathing or sheltering is a responsible factor for prolonged anestrous in buffalo-cows *(46)*. No social problem or overcrowd-ness were observed during farm inspection as judged by the overall incidence of injuries, which was much lower than the average range (5- 10%) *(29)*.

On the other hand, one of the negative aspects of the design is the lack of shading on drinking troughs, and lack of the space area per animal on drinking troughs, as judged by the increased animal density around the drinkers during daytime. Water availability is of high importance for buffalo in hot climates as they need to wallow and splash water to reduce heat load and thermal stress *(50)*.

Table 5. Weather information for the period of study.

Month	Average maximum Temperature		Average Relative Humidity (%)	THI
	(°C)	(°F)		
December	18.1	64.6	62.6	63.2
January	15.9	60.6	65.2	60.1
February	16.7	62.1	59.9	60.7
March	18.7	65.7	57.7	63.9
*April	20.3	68.5	68.0	66.7
*May	22.2	71.9	68.6	69.6
June	25.9	78.6	67.2	74.9
July	27.6	81.7	67.5	77.4
August	28.6	83.5	66.7	78.8
September	27.8	82.0	59.4	76.7
October	26.3	79.3	55.6	74.1
November	21.1	69.9	52.5	66.9

* Months in which there is some days of high THI

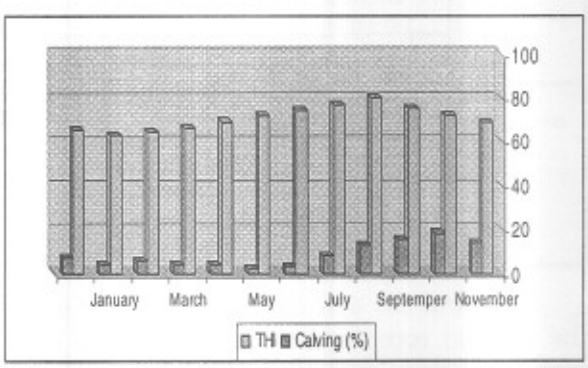


Figure 2. Monthly calving percent of the buffalo herd under different THI

Another observation regarding farm design is the sandy floor without beddings, which made a very hot surface in sunny days. Corrective measures for these faults in design will make a huge difference and help buffaloes to cope efficiently with the high temperature during summer. For proper heat alleviation evaporative cooling should also be considered, especially for summer calvings. Using of foggers or sprinklers along with blow forced air onto the cows with fans is highly recommended for intensive farming of buffalo *(4,7)*.

Despite of the importance of buffalo for the world and particularly for Egypt, researches on farm management factors that influence its productivity are scanty and limited to only few situations and sites. Studies on the epidemiology of reproductive and productive problems of buffalo under intensive farming are highly recommended to improve the welfare and productivity of this animal. This study sheds the light on the importance of raising the awareness among farm managers and owners about the importance of having efficient system for recording data, as data from individual farms are the backbone for further large scale epidemiological studies. It is also recommended to devote more researches to study efficient modifications in the design of dairy farms to cope with the special needs of buffalo.

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الملخص العربي

تأثير بعض المتغيرات المتعلقة بتصميم المزارع و المواسم المختلفة علي نسبة حدوث بعض المشاكل التناسلية في الجاموس

تيوليب عبد الحميد عبد الغفار و ياسر فؤاد مطاوع
صحة الحيوان و الدواجن و البينة
كلية الطب البيطري (جامعة بنها)

تناولت هذه الدراسة مزرعة للإنتاج المكثف للبن الجاموس حيث عانت المزرعة من ارتفاع نسبة حدوث بعض المشكلات التناسلية مثل تأخر الشياع و تأخر نزول المشيمة و كذلك سقوط المهبل و الرحم أثناء موسم الولادات الصيفي حيث سجلت هذه الحالات نسبة ٦٣,١٥%, ٤,٢١%, ١,٨٩%, ١٨,٧٤% علي التوالي. تمت الدراسة علي ثلاث محاور أساسية: أولها تفقد الحالة الصحية للحيوانات المصابة و حيوانات المزرعة ككل, ثانيا دراسة سجلات المزرعة و ما تحتويه من معلومات صحية و إنتاجية عن القطيع, ثالثا تفقد المزرعة ككل و تصميم أماكن الإيواء و كذلك نظام إدارة المزرعة. خلصت الدراسة إلي استبعاد عامل سوء التغذية و كذلك نقص الكالسيوم في الدم كمسببات للمشاكل التناسلية محل الدراسة في هذه المزرعة, بينما برزت بعض عيوب التصميم مثل: عدم قدرة الحيوانات علي الاستغلال الكامل لأماكن الراحة تحت المظلة لعدم استواء السطح و وجود بعض البروزات الأسمنتية و كذلك قلة المساحة المتاحة للحيوانات عند أحواض الشرب و عدم وجود مظلات عليها و أيضا استخدام الأرضية الرملية و تعرضها المباشر للشمس. و تلقي هذه العيوب في التصميم الضوء علي عدم مراعاة فريق إدارة المزرعة للنظم السليمة لمساعدة الحيوانات علي التخلص من العبء الحراري و الذي أستمر لمدة خمسة شهور (من يونيه إلي أكتوبر) كما بين مؤشر الحرارة و الرطوبة و الذي سجل قيم أعلي من "٧٢" خلال هذه الأشهر الخمسة مما قد يشكل سببا رئيسيا لارتفاع معدلات الإصابة أثناء الصيف و بعض شهور الخريف. و تؤكد هذه الدراسة علي أهمية مراعاة طبيعة الجاموس و تحوير تصميم إنتاج الألبان الخاصة بالأبقار حتى تتناسب مع احتياجات الجاموس و تساعده علي التخلص من العبء الحراري أثناء الموسم الحار, كذلك التأكيد علي أهمية و دقة تسجيل البيانات في السجلات و عدم إهمال تسجيل بيانات الطلوقة بشأن نشاطه الجنسي و أخذ عينات دورية لتقدير خصوبته.