Stress impedes Reproductive Physiology in Bovine Animals

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Challenges under tropical environments

- Extreme seasonal variations and summer stress.
- Maintain primary body functions within optimum ranges.
- Malnutrition and prevalence of diseases exert further stresses.
- The animal has to revisit its priorities for the body functions,
- Survival remains the topmost priority over growth, productivity and fertility.
- Reproduction gets the last priority for nutritional partitioning
- Reproduction is the first to be affected by any type of stress.
- The local breeds of dairy animals are well adapted to local environment.
- Temperature variation, feed availability and diseases prevalence.
- Stress factors do affect the reproductive physiology and lactation, adversely.

The Hypothalamus-Pituitary-Gonadal/Adrenal Axes

- The hypothalamus, controlling most of the body systems, regulate functions of various organs through pituitary gland in a coordinated way.
- HPA and HPG axes work alternatively and reproductive axis works in absence of stress.
- Animals have to maintain their primary body functions within optimum ranges during the extreme seasonal variations, especially the thermal stresses during summer.
- The malnutrition and prevalence of diseases exert further stresses.
- Under such circumstances the animal has to revisit its priorities for the body functions.
- Survival remains the topmost priority over growth, productivity and fertility.
- Reproduction gets the last priority for nutritional partitioning and hence it is the first to be affected by any type of stress.

The Crossbreeding Effect

- The genetically improved animals exhibit repeat breeding probably due to delayed ovulation under stress conditions.
- There is a need to investigate the relationship among various stressors like:
  - higher milk yield
  - abnormal levels of blood metabolites
  - ambient temperature
  - effect reproductive physiology
- Relationship of stress indicators like reactive oxygen species and enzymes with pituitary, adrenal and ovarian hormones needs exploration.
- The stress comprises nutritional, health and thermal factors and is revealed by the inability of an animal to cope with its environment.
- A phenomenon that is often reflected in a failure to achieve genetic potential.

Genetic Improvement vs Resistance to Stress

- Being in the original habitats, the local breeds of dairy animals are well adapted to local environment of climatic variation, feed availability and diseases prevalence.
- The stress factors do affect the reproductive physiology and lactation, adversely (Halliwell and Gutteridge, 1999).
- Resistance to stress is reduced with the genetic improvement coupled with productivity enhancement of animals.
- The genetically improved animals exhibit repeat breeding probably due to delayed ovulation under stress conditions.
- Relationship of stressors like higher milk yield, abnormal levels of blood metabolites and ambient temperature, with reproductive physiology, needs investigations.
- Reactive oxygen species and enzymes, affecting functions of pituitary, adrenal and ovarian hormones, needs exploration.

Early Lactation Stress

- In early lactation, stored energy, protein and mineral reserves from body fat, muscle, and bones are mobilised to meet the nutrient demands of lactogenesis.
- Nutrient demand exceeds nutrient intake during early lactation, leading to NEB.
- Body fat mobilisation releases fatty acids, which are converted to energy by the liver.
- When NEB is severe, the liver can become overwhelmed, causing the production of ketone bodies, like beta-hydroxybutyrate (BHB), excess of which may cause ketosis..
- The recovery from BCS loss during the early postpartum period is slow.
- A variety of endocrine regulatory points exist whereby stress limits reproduction.
- Stressors interfere with precise timings of hormonal release e.g. delay in LH surge.

Nutrition-Reproduction Interaction

- The author has reported reproductive and productive disorders associated with crossbreeding in cattle (Qureshi MS, JAPS, 22 (2 Suppl., 2012, pp.75-78).
- Excess intake of crude protein, associated with higher serum urea levels and low energy intake, associated with poor body condition, are the key factors for low reproductive efficiency.
- It may be corrected by adopting a proper feeding strategy.
- We also reported a decline in milk with advancement pregnancy was slight up to a point which was declared as joining point; thereafter the decline was much greater, showing a pregnancy stress on milk yield (Qureshi et al 2007, Italian JAS 6: 1290-93).
- Milk production stress lowered milk progesterone concentration in buffaloes.
- Dairy animals need an optimum range of metabolites, body condition score, nutritional status and management conditions to express reproductive cyclicity at its best level.

Energy Intake, BCS and Reproduction

- In the genetically improved dairy animals the blood metabolites are channelized for milk synthesis as a top priority phenomenon.
- Rasby et al. (1992) reported that nutrition restriction prevents LH release.
- Animals in anestrous showed decrease in diameter of the dominant follicle and in ovulation rate to the GnRH treatment.
- Negative effect of low BCS on ovarian cyclicity and pregnancy rates have been reported in beef cows (D'occhio et al., 1990; Viscarra et al., 1998).
- BCS is a useful indicator of energy status and rebreeding potential (DeRouen et al., 1994).
- Buffaloes may have to present BCS ≥ 3.5 for a satisfactory response to the treatment with GnRH and prostaglandins for fixed time artificial insemination (FTAI).
- In peri-urban dairy farmers in north-western Pakistan, shortest postpartum ovulation interval was noted during autumn (August to October) and the incidence of silent ovulations was lowest (Qureshi et al., 1999a).

Seasonality of Reproduction

- Seasonality of breeding has been associated with changing daylight length, availability of fodders mass and changes in ambient temperatures (Qureshi et al 1999, AJAS 12 (7): 1025-1030).
- Buffalo is a photoperiodic species and like sheep, it has to be considered a “short day” species. They have heats throughout the year but are more fertile when daylight hours decrease.
- According to Zicarelli (1995, Buff J 2: 17-38), this characteristic is due to their tropical origins; in fact, in these areas the availability of forage coincides with the period in which dark hours increase.
- Vale suggested that THI >75 has a negative effect on reproductive performance of buffaloes ((Vale 2007,Proc. 13th Int. Cong. Anim. Reprod., pp.19-33).
- Opposite trend of breeding has been reported in buffaloes and cows which has been noted as a blessing for countries like Pakistan (Shah et al., 1989, Anim Reprod Sci, 21: 177-190).

Normal and Low Breeding Seasons

- Qureshi et al. (1999a) reported that the buffaloes calving during the normal breeding season (NBS, August to January) ($p<0.01$) showed postpartum estrus interval of 55.95 days versus 91.15 days in those calving during the low breeding season (LBS, February to July).
- Milk progesterone levels (MPL) in the LBS remained lower than the NBS ($p<0.01$).
- Shortest postpartum ovulation interval was noted during autumn, followed by winter, summer and spring.
- The incidence of silent ovulations was higher during LBS than NBS (70.6% versus 29.4%).
- In a concurrent study (Qureshi et al., 1999b, 2002), milk progesterone levels in buffaloes showed a pattern opposite to atmospheric temperature.
- In NBS calvers serum glucose levels were higher ($p<0.01$) and magnesium lower.
- Increasing suckling duration and use of oxytocin delayed POI; one month was safe (Qureshi and Ahmad, Anim Reprod Sci, 106: 390-392).

Stress Markers and Management explored at UAP-PhDs

- HF and x-bred cows showed more oxidative stress than locals (Khan 2016 PJZ 48(5), 1431-1441).
- Holstein Frisian and crossbred cows showed more favorable response to vitamin E supplementation in respect of expression of stress and reproductive markers (Ihsanullah et al 2016, PJZ 48, 923-930).
- Heat stress increased blood cortisol and protein, and reduced milk yield in dairy cows irrespective of the genetic makeup (Ihsanullah et al 2017, Int J Biometeorol 61, 1561–1569).
- Vitamin E and Se supplementation improved the physiological, hormonal and antioxidant status in Damani and Balkhi sheep (Shakirullah et al 2017, App Biol Chem 60, 585–590).
- Increased postpartum serum progesterone levels were associated with decreased serum cortisol and higher cholesterol and glucose (Saqib et al 2018, App Biol Chem 61, 107–111).
- Better BCS and delayed lactation stage influence milk yield, stress reduction and restoration of ovarian activity in buffaloes (Saqib et al 2022, Reprod Dom Anim 57(5):498-504).