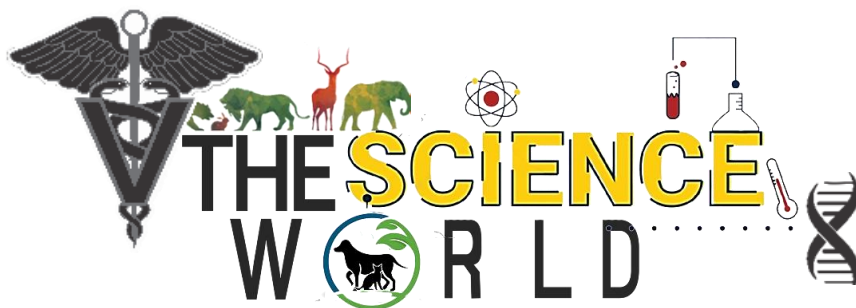




A Monthly e Magazine
ISSN:2583-2212

Popular Article

Sept, 2026 Vol.6(9), 2641-2644

Pregnancy-Associated Glycoproteins in Buffaloes: A Molecular Signal of Pregnancy

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doi.org/10.5281/ScienceWorld.22831709

Abstract

Early pregnancy diagnosis is important for efficient reproductive management of buffaloes. Conventional methods such as rectal palpation and ultrasonography are useful, but researchers have also explored biological markers that can be detected in blood. Pregnancy-associated glycoproteins (PAGs) are a group of proteins produced by specialized cells of the developing placenta and released into maternal circulation. Their concentrations increase during pregnancy, making them useful biomarkers for pregnancy diagnosis. Studies in buffaloes have demonstrated that PAGs can distinguish pregnant from non-pregnant animals from approximately four weeks after breeding. This article briefly describes PAGs, their origin, changes during pregnancy and their potential role in improving buffalo reproductive management.

Keywords: Buffalo, pregnancy-associated glycoproteins, PAGs, pregnancy diagnosis, placenta, biomarker

Why Is Early Pregnancy Diagnosis Important?

Knowing whether a buffalo is pregnant is essential for reproductive and farm management. An animal that has failed to conceive can be identified and returned to the breeding programme, while confirmed pregnant animals can be managed according to their stage of pregnancy. Rectal palpation and ultrasonography [1] are commonly used methods, but their accuracy depends on the stage of pregnancy and the expertise of the operator. Studies have shown that both ultrasonography and PAG-based testing [2] can provide highly accurate pregnancy diagnosis in buffaloes from around Day 31 after mating. This has encouraged researchers to search for simple biological signals of pregnancy. One such signal comes from the placenta.

What Are Pregnancy-Associated Glycoproteins?



Pregnancy-associated glycoproteins, commonly called PAGs, are proteins produced by specialized cells of the placental trophoblast. The developing placenta releases some of these proteins into the mother's bloodstream[3]. Their presence therefore provides a biological indication that a pregnancy has been established. PAGs belong to a large family of related proteins. Importantly, different PAGs are produced at different stages of pregnancy, meaning that the PAG profile changes as pregnancy progresses. In simple terms:

Developing pregnancy → placenta develops → PAGs are produced → PAGs enter maternal blood → pregnancy can be detected

PAGs in Buffaloes

Research has demonstrated that buffaloes produce multiple PAG molecules. Scientists have purified PAGs from buffalo placenta and identified several different PAG sequences. One study identified eleven buffalo PAG sequences[4] and subsequently developed a buffalo PAG-specific radioimmunoassay for pregnancy diagnosis. This discovery showed that buffalo pregnancy is associated with a complex family of placental proteins rather than a single pregnancy marker.

How Do PAG Levels Change During Pregnancy?

PAG concentrations are generally very low in non-pregnant buffaloes but increase during pregnancy. In one study, PAG concentrations were significantly different between pregnant and non-pregnant buffaloes from approximately Day 23 after artificial insemination. Diagnostic sensitivity reached 98% by Day 28, while specificity remained at 100% in the study population. PAG concentrations subsequently increased during early pregnancy and remained elevated for much of gestation[5]. After calving, PAG concentrations gradually declined. These changes make PAGs useful as biological indicators of pregnancy.

From Blood Sample to Pregnancy Test

PAGs can be measured using immunological techniques such as radioimmunoassay (RIA) and enzyme-linked immunosorbent assay (ELISA). More recent work has evaluated commercial PAG-based ELISA and rapid tests using blood, serum and milk from Nili-Ravi buffaloes. In that study, PAG-based testing showed more than 90% accuracy by Day 35 after breeding. This creates the possibility of detecting pregnancy without directly examining the reproductive tract. A small biological sample could provide important reproductive information.

Beyond Pregnancy Diagnosis

PAGs may have applications beyond simply answering “Is the buffalo pregnant?” Researchers are investigating whether PAG measurements can also help identify pregnancy



failure or embryonic loss[6]. Because PAG concentrations are associated with placental activity, changes in their levels may provide information about the progression of pregnancy. However, these applications require further validation before they can become routine diagnostic tools.

Future Prospects

PAG research has moved from identifying placental proteins to developing assays that can detect them in practical samples. Future pregnancy tests may become faster, simpler and more suitable for use directly on farms. Combining PAG testing with ultrasonography and other reproductive indicators could provide veterinarians with a more complete picture of pregnancy status. For buffalo production, such tools could help reduce the time between breeding and pregnancy diagnosis and improve reproductive management.

Conclusion

Pregnancy leaves behind a molecular signal. Pregnancy-associated glycoproteins are produced by the developing buffalo placenta and released into maternal circulation, where they can be detected as indicators of pregnancy. Research has demonstrated their potential for early pregnancy diagnosis and has opened the possibility of using PAGs for monitoring pregnancy more broadly. What begins as a microscopic signal from the placenta could therefore become a practical tool for improving buffalo reproductive management.

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