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RESEARCH ARTICLE

TECHNIQUES AND PROTOCOLS FOR OESTRUS SYNCHRONIZATION IN INDIGENOUS WEST AFRICAN DWARF (WAD) GOAT: A REVIEW

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ABSTRACT

Oestrus Synchronization is a reproductive tool that assist farmers breed their animals within a Shorter predetermined time. Oestrus Synchronization is aimed at controlling the luteal phase of oestrus cycle using two major devices.(a)Using prostaglandins or its analogues to reduce the life of the corpus lutea or induce premature luteolysis.(b)Using exogenous rogester one to prolong the life of the corpus lutea, especially when the reproductive status of the goats is not yet determined. Use of prostaglandins is more effective in cycling goats. Some of the popular pharmaceuticals in the country are: i. Lutalyse, ii. Estrumate, iii. Estro PLAN, iv. Fluorogesterone acetate, v. Sil-Oestrus, vi. Medroxyl-progesterone acetate, ii. Synchromate-B, viii. PMSG ix. Controlled Internal Drug Release (CIDR) devices. Oestrus Synchronization techniques in WAD goats have not been widely adopted in spite of the qualities of the WAD goats because of the poor availability and obvious high costs of aforementioned pharmaceutical agents. The adoption of gonadotrophins in oestrus Synchronization protocols have been widely reported to improve oestrus responses in WAD goats. Efficiency of oestrus Synchronization are influenced by season and increasing the dose levels of exogenous hormones have generated variable results. Factors such as combining male stimuli with exogenous hormones, proper labeling of products (extra label for sheep and goats) and improvement of management techniques especially nutritional status of the animals would go a long way towards enhancing the efficiency of oestrus Synchronization in WAD goats.

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INTRODUCTION

There is an increasing gap between the growth rate in the global human population and the availability of animal protein, with the developing countries being vulnerable to this gap (Raize et al., 2012). Goat is a multi-purpose animal providing meat, milk, clothing, fertilizer, offering Royalty and companionship, etc. The animal is alert, intelligent, and socially inclined. This animal forms an important economic and ecological niche in agricultural system throughout the developing countries. They are the most prolific of all domesticated ruminants and are able to breed all year round.

Goat is also one of the first animals to be domesticated by man. Goats are among the cleanest of all farm animals. They will not lay in filth nor will they eat contaminated foods, unless they are being forced to by poor management. Goats are preferred dairy choice in many countries (Aina, 2012).

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The West African dwarf goat (WAD) is widely distributed across the rainforest belt of Southern Nigeria, where it makes significant contributions to the livelihoods of impoverished families. The potential of WAD goat in the poverty alleviation programmes is well recognized, but is still largely untapped. This breed is known to display a wide range of qualitative variations in goat colour (black, brown, white, pied, mottled, mixed, etc) (Odubote, 1994; Ozoje and Mgbere, 2002). They are trypanotolerant and scavengers. There is a considerable potential for increased goat production and this depends on the recognition of their significance in supplying proteins of high biological value in the forms of meat and milk (Mamabolo and Wedd, 2015). The sheep and goat breeds in Nigeria are meat producing animals adopted to the various ecological zones in which they are found. The highest concentration being Kano, Sokoto, Borno and Kaduna States. They are kept largely by rural populace and they are mainly managed traditionally by farmers. It has been estimated that goats contribute 16% and sheep 5% of total domestically produced meat in Nigeria which has been estimated at 813, 000 tonnes of meat per anum (Ensminger, 1991).

There are three recognized breeds of goats in Nigeria viz; Red Sokoto found mostly in the North. The West African Dwarf, found predominantly in the South and the Sahel breed (Bornu goats) found also in the North. Sheep and goats skin have been estimated at 7,500 tonnes and 20,400 annually (Ensminger, 1991). They are handy during certain occasions, like marriages, festivals, burial and naming ceremonies, Outside the meat and milk. They also supply cash to the rural dwellers. Owing to the great potentials that goat production signifies, various efforts are being made to apply reproductive biotechnologies, including oestrus Synchronization to maximize their meat and milk production, as well control their productivity. Oestrus Synchronizaton is one of such important management technologies that have been used to enhance reproduction and genetic improvements in goats (Omontese *et al*; 2010; Riaz *et al*; 2012; Holtz, 2015).

Oestrus Synchronization Technique

Several methods have been developed to induce oestrus in goats, allowing farmers to raise kids to meet market demands for meat and milk (Abecia *et al*; 2011). One of such reproductive management technologies is oestrus Synchronization.

Benefits of Oestrus Synchronization

- Oestrus Synchronization enables concentrated breeding that ensures uniform kid cropping and easier management of pregnant does. It enables kidding over a limited period thereby allowing producers to give optimum care for the dams and kids in turn to reduce kid mortality (Whitley and Jackson, 2004).
- Farmers are able to use more efficiently, complementary techniques for reproductive management, such as artificial insemination, multiple ovulation and embryo transfer.
- It enables a compact mating and kidding period which encourages farmers to time the period of kidding to the optimum time of the year or when sufficient feeds are available.
- By Synchronization, a large number of does in the herd to the same time or period, allows an inseminator to join all does in a community to one or two periods in a year than having to inseminate individual does at a time.
- Synchronization ensures better oestrus detection, shortening of kidding intervals, concentration of kid crop, induction of puberty in doelings and more efficient use of labour and facilities.
- Concentration of kid crop (Compact Kidding) increases the period of Lactation in does and thereby increases production.
- Compact kidding enables does to regain condition before the next mating (Tsewang, 2016).
- oestrus Synchronization would serve as a promising strategy towards enhancing productivity and sustainability of WAD and this will go a long way towards improving the per capita income of commercial goat farmers.
- Oestrus Synchronization increases the chances of response to oestrus, duration of oestrus and over all chances of conception.
- A shortened kidding period would facilitate improvement in management and closer observation, herd health, uniformity in timing of vaccinations and routine management practices resulting in decreased labour requirements.
- Goat nutrition can be improved by grouping goats according to stage of gestation and feeding each group accordingly.
- The kid crop will be more uniform in age and size which is a good marketing products.

Oestrus Synchronization is important in the life of does because, there exists some variations in the duration of both the oestrus cycle and oestrus proper and moreover because, oestrus detection cannot be achieved successfully without a buck (Jainudeen, *et al*., 2000). The term “oestrus” refers to the point of female sexual excitement in does; which causes ovulation. At ovulation, does are most receptive to mating. This is the period referred to as the “Heat Period”.

Does are in oestrus when they stand to be mounted by a buck. Some of the features of heat period include;

- Creamy vulval discharges,
- Seeking out the bucks
- Constant vocalizations, loss of appetite, restlessness and Social behaviours such as rubbing up against mates,
- redness and swelling around the vulva among others. Oestrus Synchronization is process of inducing does to come on heat within a short time frame (36 to 96 hours). This can be achieved through the use of hormones.

Exogenous hormones are used to modify the physiological chain of events involved in the sexual cycle, while the non-hormonal methods of oestrus synchronization involves the use of light control or exposure to a buck. Chances are higher in the does during the luteal phase, which is of longer duration and more responsive to manipulation (Wildeus, 2000., Holtz, 2005). It is advisable to establish “Synchrony” in any oestrus synchronization technique and to ensure reasonable levels of fertility in the synchronized cycle (Rahman, *et al*, 2008). It is note worthy to emphasize that the effectiveness of an oestrus synchronization technique depends on some intrinsic and extrinsic factors (Melican, *et al*, 2008). Choosing an Oestrus Synchronization system that can be used with artificial insemination or with natural breeding can be difficult, as a number of protocols for Synchronizing oestrus are available. Traditional protocols are designed to mimic or control the corpus luteum on the ovary. New protocols have now been designed to control ovulation and / or the follicular waves that occur on the ovary during the 21-day oestrus cycle. Oestrus Synchronization Systems vary in costs, labour requirements and effectiveness. One consideration when choosing an oestrus synchronization protocol is determining if sufficient labour and facilities are available to successfully implement the protocol. For instance, Do you have adequate facilities?, Do you have enough labour to observe oestrus and sort does two or more times daily or do you need to use timed-insemination?, If a labour and technician time is not a limiting factor, then, you might consider an oestrus synchronization system that is suitable for insemination after oestrus is detected.

Another consideration is cost. Cost for oestrus synchronization protocols can vary significantly. The cheaper systems typically require more labour and are less effective. It can also be argued that breeding after oestrus detection, or with a timed artificial insemination yield similar pregnancy rates. Thus, one difference in cost may be associated with labour involved. This would of cause be dependent upon what rate you charge the labour. Many protocols can be used to synchronize oestrus cycle and ovulation and choosing a protocol may be the most difficult, considering their availability and costs. This review is aimed at explaining the techniques and protocols used in oestrus synchronization to achieve consistent, satisfactory conception rates in WAD goats.

Devices or Endocrine control of Oestrus in west African Dwarf goat

The efficiency of 'SYNCH' depends on many factors including season, exposure to males, breed and age among others. As the popularity of goat production continues to increase, pressure to develop efficient and cost-effective method for oestrus synchronization in goat become more important. An easy to apply method of oestrus synchronization in goat is by the use of prostaglandins to cause luteolysis so as to induce the subsequent follicular phase of oestrus cycle. Does responds better to oestrus synchronization protocols if they are presynchronized first. Presynsynchronization gets does to a point in their oestrus cycle when they respond best to oestrus synchronization. One of the common presynchronization protocols is prostaglagins $F_{2\ \alpha}$ as a luteolytic agent. $PGF_{2\alpha}$ are rapidly metabolized and can be administered intramuscularly and subcutaneously. Natural $PGF_{2\alpha}$ has been employed to induce luteolysis; however, some synthetic agents of them have been developed and are adjudged to have more dramatic effect on the synthesis of progesterone. Commonest natural protagladins are mostly marketed as lutalyse® and carboprost® while Fenprostenol® Estrumate® and estroPLAN® are some of the synthetic ones (Omontese, *et al*, 2012).

Akuso and Egbunike (1984) had achieved nearly a two – week reduction by decreasing average time to first oestrus when they administered two intramuscular injections of 0, 5 or 10mg of Lutalyse®, 11 days apart to WAD does. Similarly, Kawu (2000) observed that 7.5mg lutalyse® injection was very effective in Synchronizing oestrus in the three different seasons (hot-dry, rainy and harmattan) in Nigeria. Pierson *et al*; (2001) had detected a seasonal shift in the intervals to on-set of oestrus, leutenizing hormones surge and ovulation after MAP sponge removal in WAD goat treated in November, July, or March; whereas the intervals between on-set of oestrus and the LH surge and between the LH surge and ovulation were not influenced by season. However, in a follow-up study using MAP sponges singly or in combination with Gonadotrophin releasing hormone (GnRH), Season had a significant effect on the timing and synchrony of oestrus with and without GnRH treatment (Pierson et al, 2003). Also, in seasonally an-oestrus Boer and Boer crossbred does at approximately 30 days lactation, temporary kid removal and / or male exposure (both of which were effective in SYNCH previously) failed to induce oestrus in any doe (Pierson, *et al*, 2003).

In another study to evaluate the effect of equine chorionic gonadotrophin (eCG) administration at the end of prostaglandin treatment on oestrus response in red Sokoto and Sahel does, higher response was observed in does treated with a combination of eCG and $PGF_{2\alpha}$ than does treated with $PGF_{2\alpha}$ or eCG alone (Omontese, *et al*, 2014). It goes without suggesting that, eCG enhances the efficacy of prostaglandin based oestrus synchronization in does. Factors like exposure to bucks (during heat detection) and does in proesturs / oestrus also hastened time to first oestrus in FGA and MAP-treated does with sponges removed 48hours after contemporaries (Romano, 2002). Dose level of prostaglandin; the intervals between administration, the responsiveness of the corpus Luteum to the prostaglandin; Stage of the oestrus cycle (Lassal, *et al*, 2004), and the inclusion of gonadotrophins as co-treatment (Omontese, *et al*, 2013). Example of such gonadotrophins utilized as co-treatment protocols are (i) Follicle Stimulating hormone (ii) pregnant mare serum gonadotrophin (iii) Gonadotrophin-releasing hormone.

Rubiaries and Menchaca (2003) had earlier advised that prostaglandins should be administered early to does when the oestrus cycle is at day three or earlier when the corpus luteum of the does is still responsive to $PGF_{2\alpha}$. Following prostaglandin administration compromised follicular function has been reported leading to variability in the timing of ovulation (Evans, *et al*, 2004). The variability in the timing of ovulation may be removed by exposure to bucks (during heat detection). Exposure to bucks before implant removal decreased time to first oestrus in prepuberal crillo x dairy crossbred does especially when compared to teasing alone (31.6 Vs 60.0hours) and increased percentage in oestrus (91.6%), Mellado *et al*; (2002). Also, this variability can be eliminated by the use of progestagens (Pretreatment) or administration of gonadotrophins so as to promote the secretion of luteinizing hormones (Omontese, *et al*, 2013).

It is however warned that, the administration of $PGF_{2\alpha}$ will cause abortion in goats. In a related study, Alemede and Fasanya (1999) observed that the efficacy of prostaglandin treatment may be influenced by parity in WAD does. Akusu and Egbunike (1984) had earlier reported oestrus response to a range from 87 to 100% in WAD does, treated with 5mg or 10mg Lutalyse®. This finding is similar to the 100% reported by Akusu (2003) in WAD goats treatment with 10mg natural prostaglandin 11 days apart. However, Akusu and Egbunike (1984) had reported that 100% of WAD does in the 5mg $PGF_{2\alpha}$ group treatment were in oestrus within 72hours post-treatment as compared to 87.5% of the 10mg treatment. It is therefore, advisable to boost or have a second administration of the $PGF_{2\alpha}$ during the mid-luteal phase of oestrus cycle of the does around 9-11 days period. Most studies in WAD goats did not however influence significantly, the outcomes of prostaglandin treatment (Alemede and Fasanya, (1999). Another method of oestrus synchronization is by the use of natural progesterone impregnated in sponges; implants, Silicon elastomeres (Omontese, *et al*, 2016). Like prostaglandins; there are two types of progesterone (a) Natural and (b) Synthetics / Artificial.

Examples of Artificial progesterones includes (i) Norgestomet or Chronogest® (ii) Fluorogesterone acetate (FGA); (iii) methylacetoxy progesterone (MAP) (iv) medroxy progesterone acetate (MPA). Examples of Natural progesterone include (i) Sil-Oestrus implant (ii) Controlled internal drug release device (CIDR)®. Traditionally, intravaginal sponges are inserted over a periods of 9-21days combined with co-treatment of eCG or $PGF_{2\alpha}$ or both is administered two days before at the end of pessaries removal. Currently, short-term intravaginal progestagen treatment is advocated (Pintado, *et al*, 1997). Following withdrawal, does usually show overt oestrus within 48hours. More recently, an alternative means of supplying continous, exogenous progesterone has been the CIDRs; impregnated with natural progesterone (330mg). CIDRs are preferable than sponges because they are easy to use; comfortable and do not stick to the vaginal wall after use. The addition of genadotrophins to progestagen protocols ensure a tighter synchrony and induces a superovulatory response in treated doses (Drion, *et al*, 2001).

Omontese *et al*., (2013) studied oestrus synchronization using two intravaginal progestans (FGA and CIDR) for eCG – estrus induction in Red Sokoto goats during the cold dry season. The result from their study shows that progestagen retention rates were 74% (CIDR) and 68% (FGA), there were significant differences among treatments for does in oestrus (CIDR:22%; CIDR – eCG : 84%; FGA : 45%; FGA – eCG : 95%). They concluded that the use of both progestagen plus intramuscular administration of eCG improved oestrus response rates and compact Synchronization; but did not significantly improve pregnancy rates during the cold dry season. In a study to evaluate the effect of daily administration of different doses of progesterone (125mg, 25mg, 37.5mg) for 14 days on oestrus behavior of WAD does, Abu *et al*., (2008) reported higher oestrus response (66%) in the does with the lowest dose of progesterone; undermining the fact that increased dose of progesterone does not influence oestrus response. Fluorogesterone acetate (FGA) intravaginal sponges are polyurethane sponge impregnated with 30mg, 40mg or 45mg fluorogestone acetate per sponge. Each sponge contains a drawstring to allow easy removal of the sponge. FGA vaginal sponges are used for controlled breeding in goats to synchronize oestrus and ovulation. FGA vaginal sponges will not cause barren animals to become fertile.

Fluorogestone acetate is a potent progestagen, which will prolong the di-oestrus stage of the reproductive cycle allowing synchronization of the breeding cycle, in a group of goats. Following the insertion of the FGA vaginal sponge in the vagina, the sponge releases flugestone acetate, a progestagen which is absorbed and subjects the doe to a progestational action comparable to the luteal phase of the sexual cycle. This artificially imposed progestational phase is ended by removal of the sponge (Pharmplex, 2006). The sponge is inserted by using the applicator, which is disinfected either in a 10% benza-Ikonium chloride solution or 5g/L chlorhexidine gluconate solution. It is advised not to immerse the sponge in disinfectant. Using a gloved hand, the Sponge should be inserted into the end of the applicator so that the sponge is just behind the end of the applicator tube, the string is left hanging free. The applicator should be inserted 10cm to 15cm into the vagina and gently eject the sponge by pushing the applicator plunger. The applicator should be removed so that the draw string is hanging outside the vagina, after which should be wiped clean and re-immersed in disinfectant after each use. Injection with pregnant mare serum genadotrophin (PMSG) at the time of sponge removal induces a simultaneous start of the follicular phase in the treated animals. Follicles then develop and Synchronized oestrus and ovulation follow, dosage and administration oestrus is likely to occur 36hours to 48hours following Sponge removal and ovulation after a following 24hours. Induction of oestrus is enhanced following the use of PMSG, 2 days before or at the time of sponge removal (Pharmplex, 2006) Dogan *et al*., (2005) studied the efficiency of medroxy progesterone acetate (MAP) and Fluorogestone acetate (FGA) sponges with or without $PGF_{2\alpha}$ (Cloprostenol) for Synchronizing oestrus in non-lactating does was investigated during the natural breeding season. In this study, does were treated for 11 days with 60mg MAP (n=38) or 40mg FGA (n=32) sponges. All does also received intramuscular injections of 500/μ PMSG. In addition, 19 and 14 of the does synchronized with MAP and FGA respectively were injected with 125mg clopostenol and the remaining does from both groups were injected with 1.5ml of sterile saline solution, 48hours prior to the sponge removal; pregnancy rate was found to be 52.6%, 92.9%, 20.6± 0.8hours, 29.7± 1.3hours and 70.0% respectively. There were significant differences between groups: FGA/PMSG/$PGF_2\alpha$ and MAP/PMSG in terms of the duration of induced oestrus response at the first 12±6hours ($P<0.05$). These results indicate that, the use of MAP/PMSG and FGA/PMSG intravaginal progestagen treatments with or without cloprostenol are equally efficient in Synchronizing oestrus in non-lactating hair goats during the natural breeding season.

However, a comparison of sil-oestrus implant (375mg) Progesterone and veramix® intravaginal sponge (60mg) medroxy progesterone acetate) showed no difference between does in the percentage of WAD does in oestrus 100% (Akusu, 2003). Thus, it can be submitted that priming WAD with progesterone intravaginal sponge improve oestrus response to treatment with genadotrophins (Omontese, *et al*, 2013). The use of genadotrophins increases the cost of oestrus synchronization and is reported to reduce fertility of does in the long run (Wildeus, 2000). Besides, repeated administration of eCG is reported to produce antibodies against eCG (anti-eCG) thereby causing reduced ovarian stimulation after subsequent treatments (Rekwot, *et al*, 2001).

Conclusion

A number of studies have been carried out to evaluate various techniques and protocols for oestrus synchronization in the indigenous West African dwarf goats (WAD) with huge successes. The need for Oestrus Synchronization in WAD have become imperative in view of the variations surrounding their oestrus and oestrus cycles, and more because oestrus synchronization cannot be achieved without buck. The use of two major devices of prostaglandins, progestatagens and their analogues as well as their combinations have been exploited by various researchers in order to improve the Synchrony, ovulation rates and overall reproductive performance of the indigenous WAD goats. As more researchers are still on-going into more favorable techniques and protocols, for oestrus Synchronization, Goat farmers especially in the Humid Savanna Zones are encouraged to explore some of these techniques and protocols as well as combine them with good management practices and improved nutrition to achieve the much desired oestrus Synchronization in WAD goats.

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