The Potential use of Artificial Insemination in Sustainable Breeding of Dairy Goats in Developing Countries: A Case Study of Norwegian Dairy Goats in Tanzania

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Abstract

Acquisitions of live breeding dairy goats from abroad have been expensive undertakings and of late have faced tight veterinary regulations due to major disease outbreaks. Alternative strategies of acquiring new genetic material have, therefore to be tested out in order to avoid inbreeding. The use of frozen semen was investigated in Tanzania in order to increase the genetic pool and allow Tanzanian farmers to benefit from the progress of the Norwegian breeding programme. In February 2002, 46 dairy goats, including 12 first-fresheners belonging to farmers in Mgeta-division in Morogoro, Tanzania were selected for insemination. Oestrus was synchronised in all goats and followed by insemination. Twenty-five (54%) goats conceived, but only 20 goats (43%) completed the gestation period. Twenty-seven kids were born alive, of which 10 were twins and 3 were triplets. Only one kid died during first four months of life. In the next trial, a total of 20 does were inseminated, out of which 11 conceived. With this 55% conception rate, a total of 13 kids were born, out of which three died shortly after birth. Norwegian bucks born in Mgeta were introduced to three villages in the lowlands of Tanzania for upgrading local goats. Lack of resources is, however, an obstacle for comprehensive recording schemes and progeny testing. Therefore, a breeding pyramid with detailed recording and performance testing of approximately 500 breeding does belonging to Mgeta farmers has been proposed. This opens up possibilities of insemination of some of these does with semen from Norwegian elite bucks on a regular basis, thereby benefiting from the comprehensive ongoing breeding programme in that country. Bucks from Mgeta may then be moved to the lowlands for siring F_1-crosses to be used for milk production. It is concluded that occasional imports of semen from Norway for use in selected herds at Mgeta and later distribution of the resultant bucks nation-wide, may be a feasible strategy for improving the genetic base of goats in Tanzania for milk production. Mgeta Goat Breeders Association and its Norwegian counterpart could operate such a scheme with assistance of scientists in both countries thereby contributing substantially to improved human nutrition in Tanzania.

***Key words**:* Dairy goats, artificial insemination, breeding, farmers' associations

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Introduction

Despite the fact that the indigenous goats in Tanzania are tolerant to disease challenge; their small size, slow growth rates and low productivity in terms of meat and milk are setbacks to this livestock sub-sector development. The local East African goat of Tanzania has been bred naturally over centuries for hardiness and survival. Twins are rare and the doe normally produces enough milk to sustain moderate growth rate for the kid.

Several attempts have been made from the 1930s to increase goat milk production through importation of improved breeds of goats. The first effort to introduce dairy goats in Tanzania was in the middle of the 1960s (Das and Sendalo, 1991). Breeds like Toggenburg, Alpine, Saanen and Anglo-Nubian were imported into the country to improve milk production of the local goats. Kamorai breed from Pakistan was introduced to improve the mothering ability and Boer breed to improve carcass quality. However, due to inadequate continuity of development programmes as well as lack of local resources and long-term commitment, sustainable breeding programmes had not been established.

In 1982, the Department of Animal Science and Production (DASP) at Sokoine University of Agriculture (SUA) initiated a dairy goat cross breeding program with the assistance of the Norwegian Agency for Development Co-operation (NORAD). One-month-old Norwegian dairy goat kids were imported into Tanzania and multiplied, first in regions near SUA, and later distributed throughout the country. It has been demonstrated that the project succeeded in alleviating poverty among the participating dairy goat keepers by enabling them to realise cash returns and improve their household nutritional status especially among children, through the availability of goat milk in their diet (Mtenga and Kifaro, 1993; Nordhagen *et al.*, 2004). Although a buck ring was introduced, it did not work as initially planned and the project depended on the importation of live bucks from Norway. This arrangement has, however, become difficult due to increased costs and tighter veterinary regulations as a consequence of major disease outbreaks. If imports of live animals could be substituted by imports of semen to be used in special health accredited herds, the likelihood of disease transmission could be reduced. Artificial insemination (AI) in goats using fresh or frozen semen has been used commercially in several countries for many years. However, in East Africa, and particularly in Tanzania, AI in goats has rarely been performed. AI is the best way of spreading elite genetic material in a given population. Other advantages are elimination of the need for live bucks on the farm or importation of good bucks from abroad for improving the genetic constitution of the herd. In addition, the risks of inbreeding will be minimized, and there will be a wider utilization of proven sires.

This paper outlines a pyramid breeding system based on insemination in nucleus herds, in which Tanzanian goat farmers can tap genetic progress from Norwegian breeding work and at the same time minimize risk of spreading diseases. Further, this article demonstrates the use of such a technique at village level in Mgeta, Tanzania.

Materials and Methods

Mgeta division is located on the western slopes of the Uluguru Mountains in Morogoro, Tanzania, between 1100 and 1750 meters above sea level. The climate in Mgeta is quite cool, with temperatures ranging between 11 and 23°C, and an annual rainfall of about 1400 mm. This climate is suitable for intensive milk production from temperate goats.

In February, 2002 farmers in Nyandira, Mwalazi and Tchenzema villages, where the dairy goat programme was based, were approached and explained as to how the AI procedure was to be carried out, and that they were to keep the identified does away from bucks when on heat. The criteria used for selecting does for insemination were that they should have at least 75% Norwegian blood and have kidded at least once.

A total of 66 does owned by 28 different farmers were selected and ear tagged. The does were put on higher level of feeding one month before the onset of the programme, and this flushing was continued through the time of insemination and maintained up to 40 days post insemination. Since only one road leads to the large Mgeta area, and farms are connected to this road by footpaths and in order to shorten the time for the insemination team to stay in Mgeta, synchronisation of oestrus was necessary, and the farmers were requested to bring their goats to a central place for insemination. In order to synchronise the oestrus, sponges with a synthetic form of progesterone (Chronogest® for goats, Intervet, The Netherlands) were inserted into the vagina of the does. Each sponge contained 45 mg Cronolone (Fluorogestone acetate, progestagen). After ten days, the same does were injected intramuscularly with 1 ml (7.5 mg) Prosolvin® (synthetic prostaglandin $F_{2\alpha}$ analogue, Intervet). Three days later, the sponges were removed and the does injected with 400 IU Folligon® (Intervet). Folligon® consisted of the hormone equine chorionic gonadotropin (eCG) or Pregnant Mare Serum Gonadotropin (PMSG), which is rich in Follicle stimulating hormone (FSH). The ultimate aim of this estrus synchronization method was to allow artificial insemination at a predetermined time after the end of treatment. The farmers were given a sheet of paper to note down the time the doe started showing signs of heat, and to bring their animals to a central place for insemination. At this central place, the does were inseminated after confirmation of heat by standing three times for the teaser buck - i.e. the first morning and evening after arrival, and the succeeding morning.

Insemination was accomplished by lubricating and inserting into the vagina of the doe a pyrex glass speculum, size about 18 cm (7in) x 2 cm (0.875 in). A headlight was used to locate the cervix, and a graduated pipette attached to a syringe was introduced a few centimetres into the cervix and the semen deposited there.

Results

In the first round, 46 crossbred does were inseminated, out of which 25 conceived. With this 54% conception rate, a total of 27 kids were born out of which 13 were males and 14 were females. Five does gave birth to twins, while one doe gave birth to triplets. There were also five cases of abortion. In the second round, a total of 20 does were inseminated, out of which 11 conceived. With this 55% conception rate, a total of 13 kids were born out of which three died shortly after birth. The birth weight of the kids born ranged from 1.75 to 4.00 kg.

The respective farmers raised the kids until they reached breeding age. Then the bucks were examined, and selection of bucks for breeding purposes was carried out based on physical appearance, dams' performance and level of Norwegian blood. Fourteen male kids were selected, out of which three were retained for breeding purposes in the three participating villages of Mgeta division. The other 11 bucks were purchased from the farmers and distributed to three villages located over 150 km apart in the lowlands for upgrading local goats.

Discussion

Artificial Insemination (AI)

The 54 – 55% conception rate obtained in this experiment is in close agreement with those obtained by Motlomelo *et al.* (2002) of the range 47 – 60 % following the use of medroxyprogesterone acetate (MAP) and fluorogestone acetate (FGA) sponges, and controlled internal drug release (CIDR) devices for synchronising oestrus in goats. Low fertility of animals after estrus synchronisation treatment has been previously reported when the dose of progestagen was too high (Freitas *et al.*, 1996) or the duration of treatment too long (Corteel *et al.*, 1988).

AI in small ruminants, using fresh or frozen semen, has been used commercially in several countries for many years (Gordon, 1997; Romano *et al.*, 1996; Jiabi *et al.*, 2004). However, in East Africa, and particularly in Tanzania, AI in goats has rarely been performed. AI is a good method for spreading elite genetic material in a given population (Jiabi *et al.*, 2004). Other advantages are elimination of the need for live bucks on the farm or importation of good bucks from abroad for improving the genetic constitution of the herd. In addition, the risks of inbreeding can be avoided, and there will be a wider utilization of proven sires. The technique of collecting semen artificially from the best sires, freezing it and transporting it to goat populations far away, is relatively inexpensive, and there is also less risk of transmission of agents causing venereal diseases such as Camphylobacter spp,, Brucella spp and Trichomonas spp. However, the cost of AI equipment and liquid nitrogen, and the need for increased labour for detection of oestrous and performance of inseminations, are the main disadvantages using this method of breeding. The disadvantages are, however, outweighed by the benefits gained.

Oestrous synchronisation in small ruminants, using progestagen combined with PMSG administration 48 h before or at progestagen withdrawal, has been extensively applied achieving an acceptable oestrous response (Greyling *et al.*, 1994; Baril *et al.*, 1993; Baril and Saumande, 2000). Progestin implants or intravaginal devices are favoured over prostaglandin regimes because of their tighter synchrony of oestrous and ovulation (Freitas *et al.*, 1997). Optimal timing of the insemination is an important factor in the success of an artificial insemination program. Does do not ovulate until late oestrous or shortly after the end of standing heat. Therefore, recognising the signs of standing heat is important. However, the optimal timing of insemination is best determined by observing changes in the cervical mucus. As the doe progresses through oestrous, mucus turns from clear and thin at the beginning of standing heat to cloudy and stringy at middle to late heat. Insemination should be performed in does before or at the time when the mucus turns cloudy, which is usually 12 to 15 hours after the onset of oestrous. If the doe continues to exhibit heat after insemination, she should be inseminated again after 12 hours, particularly if the program uses frozen semen or cooled semen. In dairy goats, does should be observed for heat using a teaser buck and inseminated accordingly.

Since the aim of the project was to obtain bucks with high levels of Norwegian blood to be used for improving the genetic make up of the local goats and minimise inbreeding, the does were left with the farmers who were advised to keep them or sell them to potential clients. The problem of inbreeding in dairy goats in Mgeta was reduced using this approach because the farmers themselves were not capable of acquiring replacement bucks from outside the Mgeta area. AI seems to be a much cheaper way of obtaining breeding bucks than importing them from Europe or elsewhere and with fewer risks.

Record Keeping and Breeding

Animal Recording Schemes are a prerequisite for any efficient and sustainable breeding programme. In Norway, such recording schemes have evolved over a century, and, due to their importance in disease control measures and public health, they are given government support. The goat breeding in Norway is based on progeny testing of young bucks in breeding circles and distribution of superior genes by semen (Trodahl *et al.*, 1981). Due to the Norwegian eradication programme for the Caprine Arthritis Encephalitis (CAE) virus, use of AI will be increased to minimise movement of live animals between herds.

When dairy goats were introduced in Mgeta villages in Tanzania, one person was assigned to assist farmers in record keeping, organisation of breeding and other supportive services. The Mgeta Goat Breeders Association managed to upkeep the organised work for some years, before it eventually collapsed. Lack of funding for the extension services, lack of funds for testing of goats and high prices of live animals that encouraged selling of purebred goats and upgrading new ones, may explain the difficulties experienced in establishing a long-term breeding programme for Norwegian goats in Tanzania.

Partnership between Norwegian and Tanzanian Goat Associations and Research Institutions; a path to sustainable dairy goat breeding in Tanzania

In Norway, a co-operative breeding programme based on 50,000 milking goats is well established alongside animal recording schemes (Trodahl *et al.*, 1981), and more recently an eradication and control programme for important diseases is also established (Leine, 2005). The Norwegian goats have proven their merits in providing cheap milk protein in rural households of Tanzania (Mtenga and Kifaro, 1993; Mtenga *et al.*, 2002; Nordhagen *et. al*, 2004). The co-operation between Tanzanian and Norwegian farmers keeping dairy goats are planned in three levels and will be managed jointly by the Sokoine University of Agriculture (SUA) in Tanzania and the Norwegian University of Life Sciences in Norway.

Level 1 consists of the use of the Norwegian pool of dairy goats, including frozen semen from elite sires used during a 30 years period in the country. The long period, and the high number of sires, allows selection for special traits. For example, Tanzanian farmers prefer white goats suitable for hand milking.

The main component in Level 2 is the establishment of a Breeding Centre with a herd of health accredited and carefully recorded Norwegian goats at SUA. To avoid inbreeding, a breeding strategy for minimising the risk of inbreeding will be established as explained by Syrstad (2003) and Ekstrøm (2004). In order to utilise progress within the ongoing Norwegian breeding programme, semen will also be imported on a regular basis.

Level 3 includes the involvement of dairy goat farmers as breeders who will buy pedigree bucks at affordable prices. Tanzanian goat farmers will form their own associations, thereby increasing the number of recorded animals in the country. As the goat is often characterised as the poor man's cow in a poor country, extensive goat recording schemes will take some time to be established in developing countries.

Conclusion

Dairy goat keeping is becoming increasingly popular as a means of improving nutrition and socio-economic returns in low-income households of Tanzania. Sustainable recording and breeding programmes based on farmers' own resources are yet to be established. In the meantime, a strategy based on partnership between the Norwegian Goat Association, research institutions and gradually grass root farmers' associations should be introduced and supported.

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