



Full Length Research Paper

Effects of oocyte collection techniques on the recovery efficiency and *in vitro* maturation and fertilization of goat oocytes

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The experiment was undertaken to study the effect of collection techniques on cumulus oocyte complexes (COCs) recovery, *IN VITRO* maturation (IVM) and *IN VITRO* fertilization (IVF) of goat oocytes. COCs were collected by three techniques viz. puncture, slicing and aspiration of goat ovaries obtained at slaughterhouse. It was observed that, the total number of COCs/ovary as well as the number of abnormal COCs/ovary were significantly higher ($p < 0.01$) in puncture (4.22 and 2.38, respectively) and slicing (4.14 and 2.22, respectively) followed by aspiration (3.28 and 0.80, respectively) technique. In contrast, the number of normal COCs/ovary was significantly higher ($p < 0.01$) in aspiration (2.48) followed by slicing (1.91) and puncture (1.85) techniques. Only normal quality COCs were cultured in TCM-199 supplemented with 2.5% bovine serum albumin (BSA) plus 10% goat follicular fluid (gFF). The matured COCs were then fertilized in BO medium with fresh buck semen. The results showed that the rates of COCs that reached the maximum cumulus cell expansion (level-3) were 64.14, 65.93 and 65.73%; metaphase-II (M-II) stage were 57.75, 58.23 and 58.57%; normal fertilization (formation of male and female pronuclei) were 34.43, 35.03 and 34.65% in puncture, slicing and aspiration techniques, respectively; there were no significant differences among these rates. The results revealed that the collection techniques have no significant effect ($p > 0.05$) on *IN VITRO* maturation and fertilization of goat oocytes as long as normal quality COCs was used.

Key words: Collection techniques, cumulus oocyte complexes (COCs), *in vitro* maturation (IVM), *in vitro* fertilization (IVF).

INTRODUCTION

Over the last ten to fifteen years, after a dramatic development of cellular biology, a lot of research efforts have been moved towards the implementation of embryo technologies involving multiple ovulation and embryo transfer (MOET), *in vitro* production (IVP) of embryos, cloning and transgenesis to transfer a targeted number of

embryos. Among all, IVP of embryos has become a routine method of producing embryos from abattoir-derived ovaries with minimal cost. Although, goat oocytes can be recovered in relatively large numbers from abattoir ovaries, the oocytes frequently have reduced development potential when compared to *in vivo* matured

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or immature oocytes collected after gonadotropin treatment (Cognie et al., 2003). Poor development potential starts with maturation that limits the suitability of these oocytes for research biotechnology and slows the application of *in vitro* embryo production to commercial embryo transfer. The cumulus cells (CCs) surrounding the oocyte plays a key role in oocyte maturation, and they are known to supply nutrients, energy substrates (Sutton et al., 2003) and/or messenger molecules for the development of oocytes (Buccione et al., 1990) and to mediate the effects of hormones on the cumulus oocyte complexes (COCs) (Zuelke and Brackett, 1990). Cumulus cell concentration is very much dependent on the efficiency of oocyte harvesting. Several methods have been used for harvesting oocytes from slaughter-house ovaries of farm animals. A number of research works have been conducted to compare the efficiency of the oocyte collection techniques in cattle (Katska, 1984; Lonergan et al., 1991), sheep (Wahid et al., 1992; Wani et al., 2000) and goat (Mogas et al., 1992; Wang et al., 2007). In Bangladesh, few researches have performed IVP of goat embryos where COCs were collected only by aspiration of 2 to 6 mm diameter follicles (Ferdous, 2006, Islam et al., 2007, Mondal et al., 2008). However, no other technique was used for this purpose. Keeping the aforesaid reality in mind, the present research was undertaken to compare the effects of three oocyte collection techniques of puncture, slicing and aspiration on the recovery of efficiency, *in vitro* maturation and fertilization of goat oocytes.

MATERIALS AND METHODS

Collection and processing of ovaries and COCs

Ovaries of goats with unknown reproductive history were collected at local slaughterhouse and kept in collection vial containing 0.9% physiological saline in a thermo flask at 25 to 30°C. The ovaries were trimmed to remove the surrounding tissues and overlying bursa. Each ovary was treated with three washings in Dulbecco's phosphate-buffered saline (DPBS) and two washings in COCs collection medium (DPBS + 4 mg/ml BSA + 50 IU/ml penicillin) as developed by Wani et al. (2000) for ewe. Each ovary was processed individually and the COCs were harvested by one of the following three techniques:

Puncture

Ovaries were placed in a Petri dish (Esbee Biotech, Maharashtra, India) containing 5 ml of COCs collection medium, held with the help of forceps and the whole ovarian surface was punctured with an 18 gauge hypodermic needle.

Slicing

Ovaries were placed in a Petri dish containing 5 ml of the COCs collection medium, held with the help of forceps. Incisions were given along the whole ovarian surface using a scalpel blade.

Aspiration

Visible follicles were aspirated using an 18 gauge hypodermic

needle attached with a sterile 5 ml disposable syringe containing 2 ml harvesting medium. The media along with the collected COCs was then transferred to a 35 mm Petri dish. When collecting the COCs by puncture and slicing methods, the ovary was kept completely dipped in the medium. In all the three techniques, the Petri dishes were kept undisturbed for 5 min, allowing the COCs to settle down. Excess media were taken out by a syringe without disturbing the oocytes at the bottom of the Petri dish. The Petri dishes were then examined under an inverted microscope, and the total number of COCs harvested was counted. The COCs were graded into 4 grades on the basis of cumulus cells and nucleus as described by Khandoker et al. (2001): Grade A: oocytes completely surrounded by cumulus cells; Grade B: oocytes partially surrounded by cumulus cells; Grade C: oocytes not surrounded by cumulus cells and Grade D: degeneration observed both in oocytes and cumulus cells. The grade A and B were considered as normal and grade C and D as abnormal COCs.

Follicular fluid collection and preparation

Follicular fluid was collected from all categories of morphologically healthy surface follicles by aspiration using 10 ml syringe with 19 G needle. Criteria for assessment of follicular health established by Kruij and Dieleman (1982) for bovine ovaries were applied in this experiment to assess goat follicles: (i) Non atretic: uniform bright appearance, extensive and very fine vascularization and no free floating particles in the follicular fluid and (ii) Atretic: loss of translucency, slightly or dull grayish and/or opaque appearance and free-floating particles in follicular fluid. At each collection, fluid from each surface follicle was pooled, centrifuged 2 times at 3000 rpm for 30 min. The supernatant was collected and filtered through a 45 µm millipore filter and heat inactivated at 65°C for 1 h in a water bath, and then stored at -20°C until use.

IN VITRO maturation (IVM) of COCs

The normal quality COCs were cultured in Tissue Culture Medium-199 (TCM-199: Sigma Chemicals Co., St Louis, MO, USA) supplemented with 2.5% Bovine serum albumin (BSA) (Sigma Chemicals (St Louis, MO, USA) plus 10% goat follicular fluid (gFF) for 27 h. After maturation, the degree of cumulus cell expansion was determined according to Rahman et al. (2004) under microscope at 10x magnification as level-1: indicating less expansion of COCs; level-2: indicating moderate expansion and level-3: indicating marked expansion of cumulus cells with a compact layer or corona radiata. Thereafter, half of the matured COCs from each droplet were taken and denuded from cumulus cells by repeated pipetting. Oocytes were then placed on a glass slide, covered with cover slip, fixed with aceto-ethanol (acetic acid : ethanol, 1:3, V/V), stained with 1% aceto-orcein and examined under an inverted microscope (Olympus, Germany) at high magnification (100x) with emersion oil for germinal vesicle break down (GVBD), metaphase-I (M-I) and metaphase-II (M-II) stage.

IN VITRO fertilization

The fertilization medium, Brackett and Oliphant (BO) (Crozet et al., 1995) was prepared and its pH was adjusted to 7.8 on the day of use. Semen was collected and the sperm concentration was adjusted at 10⁶/ml. Then, insemination droplets were prepared, covered with paraffin oil (Labo America, Inc., California, USA) and kept in the CO₂ incubator for 4 to 5 h for preincubation. Then the remaining half of the matured COCs (other half was used for nuclear maturation) were transferred to each of the sperm drops and incubated for 5 h in the incubator at 38.5°C with 5% of CO₂ in

Table 3. *In vitro* fertilization of oocytes collected by different techniques.

Collection technique	Total number of oocyte taken	Pronuclei (PN) formation (%)			
		2 PN	1 PN	>2 PN	No PN
Puncture	98	34.43±0.70 (34)	1.98±0.11 (2)	2.06±0.12 (2)	61.24±0.70 (60)
Slicing	103	35.03±0.89 (36)	0.00 (0)	0.00 (0)	64.92±0.68 (67)
Aspiration	128	34.65±0.97 (44)	2.31±0.10 (3)	0.00 (0)	63.38±0.89 (81)

Values are shown in mean±SE; Means with different superscripts within the column differ significantly ($p < 0.05$); Figure in the parenthesis indicates the total number.

The fact that the maturation and fertilization rates in different collection techniques showed a similar trend (insignificant difference among collection techniques) might be due to this reason. The findings of the present study are comparable with those of cattle (Carolon et al. 1992), sheep (Wani et al., 2000) and goats (Pawshe et al., 1994) and that the maturation and fertilization rate does not depend on the collection techniques.

Conclusion

It could be concluded from the present study that aspiration of 2 to 6 mm diameter follicles is the effective technique for oocyte recovery from slaughterhouse goat ovaries, however, there was no significant ($p > 0.05$) effect of COCs collection techniques on *in vitro* maturation and fertilization in goats.

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