

## Hand-made Artificial Vagina for Goat Semen Collection in Artificial Insemination Program in the Villages

Marjuki

Faculty of Animal Husbandry, Brawijaya University, Malang, Indonesia-65145

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### ABSTRACT

Artificial vagina (AV) used for semen collection in artificial insemination program in Indonesia is supplied from import or industrially produced. The imported or industrially produced AV is generally expensive, difficult to acquire and to maintain, especially by inseminator in the remote area. This experiment aimed to assemble or develop inexpensive hand-made AV from locally available, easily obtainable, and cheaper materials, among others were a T-shape polyvinyl chloride (PVC) pipe connector, bottle stopper, air tube of motorcycle tire, shoe rubber, latex condom, rubber balloon, and scaled reaction tube.

The assembled hand-made AV in this experiment showed as same functional as imported one, but it was cheaper, easier to acquire and maintain. The hand-made AV test for bucks goat semen collection resulted normal quality of semen as reported by many authors including volume  $0.78 \pm 0.27$  ml per ejaculation; milky-white color; pH  $7.03 \pm 0.22$ ; thick consistency, viability  $68.5 \pm 14.5$  %; mass motility +++ (good); individual motility  $72.4 \pm 16.8$  %; sperm concentration per ml semen  $229.8 \pm 80.8 \times 10^7$ ; and total sperm per ejaculation  $182.9 \pm 101.6 \times 10^7$ . This normal quality of semen was appropriate for artificial insemination.

Thus, to overcome the problem in acquiring AV for semen collection in artificial insemination program, it can be assembled and used inexpensive and easy to maintain AV from locally available and easily obtainable materials.

**KEY WORDS:** pipe connector, latex condom, reaction tube, sperm, motility, viability.

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### INTRODUCTION

Artificial insemination (AI) is the most accepted technology in animal production by farmers in Indonesia. This technology has been applied for dairy cows since 1970's, later for beef cattle in 1980's and most recently for goat and sheep. The farmers have noticed some advantages of this easy and cheap technology, among others improving genetic, reproductive performance, productivity and population of livestock.

Many AI trainings either to upgrade the present inseminators or to establish new inseminators have been conducted by government livestock services and universities in the last few years to support the AI program. Recently, there are at least one or more inseminators in every sub-district of 6 to 8 villages either as government staffs, cooperative or private. The inseminators are responsible for giving AI service to livestock under the farmer's order and the farmers have to pay for the service.

However, limited supply of semen especially for goat and sheep is a constraint for the inseminators. Frozen semen for AI in the villages is normally supplied by two AI centers, which are located in Lembang and Singosari of West and East Java Province, respectively. The semen is mostly for dairy and beef cattle but limited quantity for goat and sheep. In fact, requirement of semen for goat and sheep must be much higher than those for cattle, since population of the previous animals is much higher than the latter ones. Population of sheep and goat as compared to population of beef and dairy cattle in East Java, which is one of province in Indonesia with the highest population of cattle in 2010, was 2.7 million as compared to 3.8 million heads, respectively [1]. In addition, semen for AI is supplied as frozen semen, hence, lack of its distribution and the availability of liquid nitrogen containers are other constraints for the semen supply, especially in the remote areas.

Thus, it is necessary for the inseminators to collect semen from selected males present in their area and use it as fresh for AI. The most appropriate method to collect semen for better quality of semen is using artificial vagina as compared with using electric-ejaculator and palpation [2, 3]. This research is aimed to develop inexpensive and easily to maintain hand-made artificial vagina from locally available and easily obtainable materials to support inseminators in collecting fresh semen for AI.

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\*Corresponding Author: Marjuki, Faculty of Animal Husbandry, Brawijaya University, Malang, Indonesia-65145

## MATERIALS AND METHODS

### Materials

Materials used and their functions in assembling the hand-made artificial vagina were listed in Table 1 and illustrated in Figure 1.

Table 1. Materials used in assembling hand-made artificial vagina (AV)

No.	Material	Purchased at	Functions	Price (USD)
1.	T-shape PVC pipe connector (2"-2"-1"), 1 unit	Local home depot	As jacket of the AV.	0.35
2.	Bottle stopper (1" diameter), 1 unit	Local home depot or chemical shop	To close 1" opening of the T-shape pipe connector	0.20
3.	Air tube of motorcycle tire, 2 units	Motorcycle reparation shop	One unit was fixed in the middle of bottle stopper; function as water valve to fill warm water into and to empty the AV. One unit was fixed to plastic bottle, function as a pump to fill warm water into the AV.	0.10
4.	Plastic hose, 0.6 cm diameter, 5 cm length	Local home depot	To be fixed on the tip of tire air tube fixed on bottle stopper	negligible
5.	Shoe rubber (length 20 cm, width 5 cm, thick 0.3 cm), 2 sheets	Shoe shop, toys shop or stationery shop	To seal the edge of both 2" openings of the T-shape pipe connector. To make a pocket which function as cover of reaction tube.	0.15
6.	Latex condom (cut off its tip), 1 sheet	Supermarket or apothek	As inner layer of the AV.	0.20
7.	Rubber band, 8 pieces	Supermarket	To tie both tips of condom to the edge of both 2" openings of the T-shape pipe connector.	negligible
8.	Scaled reaction tube, 1 unit	Laboratory equipments shop	As collection device of ejaculated semen	0.40
9.	Round rubber balloon (cut off its tip), 1 piece	Supermarket or toys shop	As a funnel connecting reaction tube with one of the 2" opening of the T-shape pipe connector.	0.02
10.	Water soluble lubricant	Chemical shop	To lubricate outside wall of the condom after it has been fixed to the AV jacket	negligible
11.	Glue for rubber	Supermarket	To fix rubber bottle stopper and rubber shoe on the T-shape pipe connector	0.05
12.	Plastic bottle, 1 unit	Chemical shop	As a pump to fill warm water into the AV	0.50
			<b>Total</b>	<b>1.97</b>

### Method of Assembling the AV

Assembling the AV using the materials is basically can be divided into two steps:

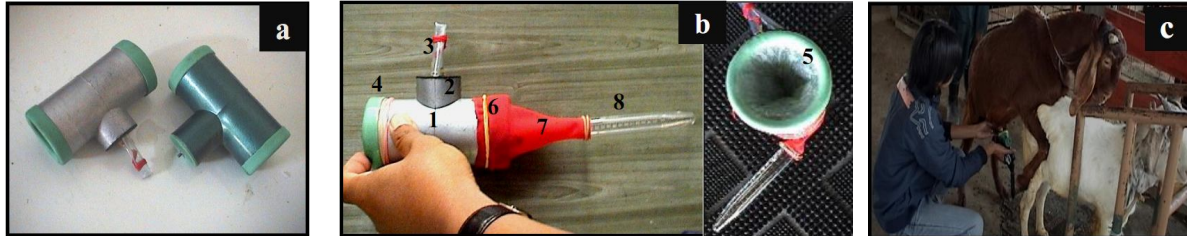
#### Step 1. Assembling the jacket of the AV

1. The motorcycle tire air tube is fixed at the middle part of the bottle stopper longitudinally, so that a hole is created from one end to another end of the bottle stopper.
2. The bottle stopper fixed with the tire air tube is then fixed to close the 1" opening of the T-shape pipe connector. It is necessary to put some rubber glue at inner surface of the 1" opening of the T-shape pipe connector and the outer surface of the bottle stopper to close firmly the opening.
3. The edges of both 2" openings of the T-shape pipe connector are completely sealed with shoe rubber of about 1.5 cm outside and another 1.5 cm inside to make the edges smooth and prevent the condom from damage (see also step 2.2).
4. The jacket of the AV is ready to use (Figure 1a).
5. Plastic bottle as water pump was prepared by fitting a motorcycle tire air tube to the cup of plastic bottle.

#### Step 2. Preparing the AV for semen collection

1. The condom and round rubber balloon are unfolded, cut off their tip, carefully washed using antiseptic soap and rinsed with clean water for several times and air dried or wrapped with clean towel. This is to sterilize them and to remove anti spermatic present in the condom before used.
2. The sterilized condom is placed inside the AV jacket, then it's both ends are stretched and folded over to the edge of the 2" openings of the T-shape pipe connector and tied firmly with rubber band. Thus, a space is created in between inside wall of the AV jacket and outer wall of the condom to be filled with warm water just before the AV is used in collecting semen (see also step 2.6).
3. The larger end of the sterilized rubber balloon is stretched and placed over on one of the 2" openings of the T-shape pipe connector and tied firmly with rubber band.
4. The scaled reaction tube is fixed to the other (smaller) end of the balloon and secured with rubber band.
5. The reaction tube is then covered with a pocket made from shoe rubber to prevent the collected semen in the tube to contact with sun-sine.

6. Some warm water (42 to 45°C) is pumped into a space in between AV jacket and condom wall using plastic bottle through the plastic hose to create friction and pressure as well as a warm temperature to simulate as a real vagina. When sufficient friction and pressure have been created, the plastic hose is folded and the plastic bottle is pulled out. The folded plastic hose is then tied with rubber band to prevent water leaking out of the AV. Finally, the wall surface of the condom is as thin as possible lubricated with a small amount of sterile water-soluble lubricant, hence, the AV is ready to use for collecting semen (Figure 1b and 1c).



**Figure 1.** Hand-made artificial vagina.

- a. Jackets of artificial vagina made from T-shape PVC pipe connector 2", 2", 1".
- b. Completely installed and ready to use hand-made artificial vagina.
- c. Hand-made artificial vagina being used to collect semen of a buck goat.

### The test of hand-made AV for semen collection

Fifteen goat bucks with two pairs of permanent incisor teeth (body weight: 27.1 to 33.6 kg) and three adult teaser does (body weight 26.5 to 29.7 kg) were used to test the use of the hand-made AV for semen collection. The goats were placed in individual pen (0.9 m width, 1.2 m length, 1.2 m height) elevated on about 0.6 m above the ground completed with feed and drinking water through. The goats were fed on *ad libitum* fresh chopped elephant grass supplemented with a concentrate feed (CP content 16.8 % DM) as much as 1.5 of individual goat body weight. Drinking water was supplied *ad libitum*.

Semen of each buck was collected twice a week for 9 weeks using the prepared hand-made AV. During semen collection, a semen collector was ready on the right side of either the teaser doe or the buck with a ready hand-made AV hold on his right hand. The bucks were allowed to do fore-mounting the teaser doe and pulled it back. This fore mounting was repeated for twice to three times until maximum penis erection was shown by the buck and then followed by a last mounting for semen ejaculation and collection. In the last mounting for semen ejaculation and collection, while holding and forwarding the AV to the penis with his right hand, another semen collector's hand was grasping the sheath of penis and directing it to the AV to let the erected penis insert and ejaculate semen to the AV. Just after semen ejaculation and usually followed by the buck to dismount, the AV was quickly removed from the penis and positioned vertically with collecting tube under the jacket to let the ejaculated semen flow to the bottom of collection tube as much as possible. After few seconds, the collection tube with semen inside was removed from the AV and the semen was as soon as possible evaluated for its volume, color, consistency, pH, sperm viability and sperm concentration using haemocytometer under light microscope.

## RESULTS AND DISCUSSION

### Hand-made AV as compared with the imported one

AV is one of main equipment in AI program for semen collection [2, 3]. So far, AV used in AI program by inseminators and AI Center in Indonesia was supplied from import. There were some disadvantages of using the imported AV. Those were expensive, difficult to acquire and maintain. In this experiment it was assembled hand-made AV as presented in Figure 1. The hand-made AV had same structures and functional as the imported ones. In addition, the hand-made AV was much cheaper, easier to prepare and maintain, since it could be manually assembled from locally available, easily obtainable and inexpensive materials (see Table 1). A unit of hand-made AV required not more than USD 2.0 for buying materials required to assemble it, while the imported AV costs at least USD 50.0 per unit.

### The hand-made AV test for semen collection

Two hand-made AVs assembled in this experiment had been tested for collecting semen of goat bucks as much as 270 times (15 bucks x twice collections per week x 9 weeks period). Quality of semen collected using the hand-made AV was presented in Table 2.

Table 2. Quality of goat bucks semen collected using hand-made AV

Variables	Mean (n = 270) <sup>1</sup>
Volume (ml)	0.78 ± 0.27
Color <sup>2</sup>	2.39 ± 0.85 (milky white)
pH	7.03 ± 0.22
Consistency <sup>3</sup>	2.65 ± 0.52 (thick)
Viability (%)	68.5 ± 14.5
Mass motility <sup>4</sup>	2.42 ± 0.77
Individual motility (%)	72.4 ± 16.8
Sperm concentration (x 10 <sup>7</sup> sperm per ml semen)	229.8 ± 80.8
Total sperm per ejaculation (x 10 <sup>7</sup> )	182.9 ± 101.6
Total progressive sperm per ejaculation (x 10 <sup>7</sup> )	135.8 ± 84.4

Notes :

<sup>1</sup>) Semen collected from 15 bucks x twice collections per week x 9 weeks period

<sup>2</sup>) Scored from 0 = clear (transparent), 1 = white, 2 = milky white, to 3 = cream

<sup>3</sup>) Scored from 1 = thin, 2 = moderate, to 3 = thick

<sup>4</sup>) Scored from 0 = very slow or no movement, 1 = slow movement, 2 = fast movement with light waves, to 3 = fast movement with thick waves.

During being tested for collecting semen, the only parts of the hand-made AV which damaged and had to be replaced after several times uses were condom and rubber balloon. The condom damaged mostly during stretching and folding over it to the AV jacket after being washed and sterilized for next uses and partly damaged due to very strong pushes by bucks when ejaculation took place. Three out of 270 ejaculations were not success because the condoms damaged due to very strong pushes by buck when ejaculation took place, resulting ejaculated semen mixed up with warm water from the AV. For the unsuccessful ejaculation, semen collections from the same bucks were repeated after giving approximately 15 minutes rest for the bucks. While, the balloon damage was mostly due to stretching when fixing the reaction tube to the balloon was being done. Average life span of the condom and balloon was  $17.9 \pm 5.3$  and  $14.7 \pm 8.4$  time uses for semen collection, respectively.

Quality of semen of buck goats collected using the hand-made AV in this experiment was in the range of semen quality of bucks goat as reported by several authors. Volume of semen per ejaculation is one of important criteria in semen evaluation and reproductive performance of male animal [4]. Average semen volume measured in this experiment was  $0.78 \pm 0.27$  ml per ejaculation with milky-white color, thick consistency and pH 7.03. Wildeus [2] and Haenlein [3] reported that volume of semen of buck goat ranged from 0.5 to 1.5 ml per ejaculation, with milky-white to cream color [5] and pH ranged from 6.5 to 7.0 [6].

Sperm concentration, viability, mass and individual motility give figures on the number and capability of spermatozoa to move and find the *oocytes* in the female reproductive tract during fertilization process. Those parameters measured in this experiment were  $229.8 \pm 80.8 \times 10^7$  spermatozoa per ml semen,  $68.5 \pm 14.5\%$ ,  $2.42 \pm 0.77$ , and  $72.4 \pm 16.8\%$ , respectively. Wildeus [2] reported that normal and good semen showed average spermatozoa concentration of  $3 \times 10^9$  or range from  $1.5$  to  $5.0 \times 10^9$  spermatozoa per ml semen, of which 60 to 80 % must be viable [7] with individual sperm motility at least 60 to 70 % [3].

## CONCLUSIONS

To overcome the problem in acquiring AV for semen collection in artificial insemination program, it can be manually assembled inexpensive AV from locally available and easily obtainable materials. The hand-made AV had as same structure and functional as, but easier to acquire and maintain than imported ones.

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## REFERENCES

1. The East Java Province Livestock Services Office, 2007. Ruminant Livestock Population in East Java from 2002 to 2006. Retrieved March 5, 2011 from <http://www.disnak-jatim.go.id/?pilih=hal&id=18>.
2. Haenlein, G.F.W., Caccese, R., Smith, M.C., 2006. Artificial Insemination. Retrieved March 5, 2011 from <http://www.goatworld.com/articles/ai/ai.shtml>

3. Ax, R.L., Dally, M.R., Didon, B.A., Lenz, R.W., Love, C.C., Varner, D.D., Hafez, B., Bellin, M.E., 2000. Artificial insemination. In: *Reproduction in Farm Animals*. E.S.E. Hafez and B. Hafez (Eds.). 7th edition, Lea & Febiger, Philadelphia, pp. 376-389.
4. Oyeyemi, M.O., Akusu, M.O., Ola-Davies, O.E., 2000. Effect of successive ejaculations on the spermiogram of West African Dwarf Goats (*Capra hircus* l.). *Veterinary Archive* 70 (4): 215-221. Retrieved March 5, 2011 from <http://www.vef.hr/vetarhiv/papers/70-4/oyeyemi.pdf>
5. Salisbury, G.W., van Demark, N.L., Codge, J.B., 1978. *Physiology of reproduction and artificial insemination of cattle*. 2nd ed. San Francisco, W.H. Freeman & Co.
6. Hullet, C.V., Shelton, M., 1987. Reproductive cycle of sheep and goat. *Reproduction in Farm Animal*. E.S.E. Hafez (Ed.). 5<sup>th</sup> edition. Lea and Febiger. Philadelphia.
7. Wildeus, S., 2000. *Reproduction and Breeding*. Goat Research. Agricultural Research and Extension Programs. Langston University. Langston, UK. Retrieved March 5, 2011 from <http://www2.luresext.edu/goats/training/reproduction.html>