

Foetal wastage and incidence of ovarian disorders in goats slaughtered at Dodoma Municipal abattoir, Tanzania

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SUMMARY

Livestock husbandry and slaughter have become millenary traditions in every part of the world. In request for meat, numerous viable embryos and fetuses are wasted due to lack of effective pregnancy detection system and thus pregnant animals are not spared in the slaughtering process. In Tanzania, limited data are available on the level of foetal wastage in small ruminants slaughtered daily. This study was carried out to establish the level of foetal wastage and prevalence of ovarian disorders in does slaughtered at Dodoma municipal abattoir for a period of seven days (September 14 – 20, 2015). Foetal age was estimated using Crown Rump Length (CRL) method. Gross ovarian lesions were observed and sampled for histopathology. The total number of goats slaughtered during the study period were 2869 representing 72.3% males and 27.7% females. Up to 412 out of 795 (51.8%) of slaughtered does were pregnant including 34.7% carrying singletons and 17.1% having twins ($p < 0.05$). Of the recovered fetuses, 60% ($n = 247$) were males whereas 40% ($n = 165$) were females. Gestation length estimated from CRL ranged from 37 to 103 days (CRL 5-35cm). Majority (80%) of fetuses were in second trimester, 12.8% first trimester and minority (7.2%) being in third trimester. The net economic value (NEV) daily forgone as a result of loss of potential offsprings at Dodoma abattoir was estimated to be between 8,610 and 14,350 US \$. The incidence of ovarian disorders was recorded in 9.6% (37/383) of non-pregnant does. Follicular and luteal cysts were seen in 7.8% ($n = 30$) and 1.8% ($n = 7$), respectively. Most of follicular cysts (65%) occurred as multiples, of which 52.9% ($n = 16$) were on the right ovary and 47.1% ($n = 14$) were on the left ovary. Luteal cysts were observed singly in either of the ovaries. Based on these findings, foetal wastage due to slaughtering of pregnant does is quite alarming at Dodoma municipal abattoir. Effective pregnancy screening before slaughter is recommended to avert the economic loss and human nutrient wastage.

Keywords: Foetal loss, ovarian disorders, slaughter goats

INTRODUCTION

Small ruminant (sheep and goats) are a source of food (meat and milk) and play an important role in providing financial security for rural populations and in improving a nation's economy (URT, 2016). In Tanzania, the annual consumption of animal protein (meat, milk, eggs and fish) amounts to 9.6 kg/person compared to the global average of 41.9 kg/person (FAO, 2013). Countries such as Australia and the USA consume approximately 111.5 kg/person/year and 120.2 kg/person/year, respectively (FAO, 2013). The comparison suggests that Tanzania ranks lower for per capita meat consumption of animal protein than other East Africa countries such as Kenya (16.7 kg/person) and Uganda (11 kg/person) (FAO, 2013).

Tanzanian's animal herd at the end of 2014/2015 included 15.6 million goat and 7 million sheep,

with 2.5% annual growth rates that are too low to satisfy the requirements of the increasing human population (URT, 2014). The Tanzanian population was estimated at over 44.9 million in 2012, with estimated annual growth rate of 3.0% and the population is estimated to be 62.3 million by 2020 (URT, 2014). Demand for animal protein which is propelled by population growth, urbanization, eating behaviour and increased income is not matching with the slow annual growth rate of domestic livestock production (Thornton, 2010). The high demand for sources of animal protein has led to practices such as indiscriminate slaughter of young and pregnant female animals, which is seen routinely in some Tanzanian abattoirs (Nonga, 2015). This practice results in wastage of scarce protein available to consumers and a decrease in the livestock growth capacity of the country owing to low herd replacement rates (Cadmus and Adesokan, 2010).

The indiscriminate slaughter of pregnant animals and the consequent wastage of embryos and

foetuses are regarded as unethical and uneconomic practice that counteracts food production efforts, restricting availability of animal protein (Abassa, 1995). The scale and impact slaughtering pregnant cows have been reported in several abattoirs in Tanzania (Mellau *et al.*, 2011; Luwumba, 2011; Msafiriet *et al.*, 2014; Tembo and Nonga, 2015), and other countries in Sub Saharan Africa (Oduguwa *et al.*, 2013; Nantongo *et al.*, 2013; Jarikre *et al.*, (2014). Substantial economic losses due to slaughter of pregnant animals at abattoirs have been estimated in Nigeria (Alhaji, 2011; Ngbede *et al.*, 2012) and Ethiopia (Tamirat *et al.*, 2015). Foetal wastage through slaughter of pregnant goats has received little or no attention over the years in Tanzania (Swai *et al.*, 2015). The objective of this work was therefore, to assess the trends and economic impacts of slaughter of pregnant female goats at Dodoma municipal abattoir.

MATERIALS AND METHODS

Study location

The study was conducted at Dodoma Municipal abattoir, located at the center of the country 400 km West of Dar-es-Salaam, the major city of Tanzania. The abattoir, which is owned by Tanzania Meat Company (TMCL) Limited, constructed in 2004, provides in the daily goat meat requirements of the inhabitants of Dodoma, neighbouring areas and for export to UAE, Oman, China, Hong Kong and Vietnam. Geographically, Dodoma municipality is between latitude 610°59.988"S and longitude 3545°0.000"E. Dodoma municipal experiences tropical climate conditions, typified by mean minimum and maximum temperatures varying from 16 ° C and 29 ° C, respectively. Annual rainfall is approximately 570 mm per year, with two distinct seasons: wet season starting in November and ends in May followed by dry season lasting from June to October.

Study animals and design

The study animals were goats brought for slaughter from all districts of Dodoma region and nearby regions of Manyala, Singida, Arusha, Tabora, Shinyanga, Iringa and Morogoro. Some animals were transported to the abattoir using vehicles and others were trekked in. The study design employed was an active abattoir survey, carried out for seven

days from September 14 – 20, 2015. After arrival at the abattoir, age, number and origin of the animals were recorded in a purposively designed record form. The age was determined based on dentition and owner's information. No pregnancy diagnosis was conducted owing to limited facility and competency.

Meat inspection protocol and data collection

Routine meat inspections or examinations were carried out by a para-veterinarian (qualified meat inspectors) using recommended standard guidelines provided by Tanzania's Meat Inspection Guidelines (URT, 1962) and as described by Gracey (1986) and the Food and Agriculture Organization of the United Nations (FAO, 1994). Intact reproductive organs included ovaries, oviducts, uterine horns and cervixes were retrieved from slaughtered goats. The uteri and the uterine horns were opened and inspected for the presence or absence of foetuses. Recovered foetuses were examined to ascertain their sex and age. Ovaries were examined for ovarian abnormalities and further processed for histopathologic examination.

Foetometry and morphometric measurements

Morphometric measurements were carried out on recovered foetuses. The sex of foetus was determined by visualizing the external genitalia (penis, prepuce, scrotal sac, nipples and genital swelling). Foetal age was estimated by measuring the crown-rump length (CRL in cm) of the foetuses as previously described by Hussein (2008). Briefly, to measure the CRL, the foetuses were laid in lateral recumbent position, fully extended and the measurement was taken from the crown (most upper part of the skull) to the rump (end of the sacrum) Fig. 1. The approximate age of the foetuses was estimated using the following equation ($GA = 2.74 X + 30.15$).

Where:

GA = Gestation age in days

X = Crown vertebral rump length in centimeter

Basing on measurements (ages), foetuses were placed into various stages of gestational ages (trimester): First trimester = 1-51 days; second trimester = 52 -102 days; and third trimester = 103 – 153 days (Gall *et al.*, 1994).



Figure 1: Measuring the crown-rump length (CRL) of the foetuses for estimation of age.

Histopathologic Technique

For morphological and histological assessment, ovaries were dehydrated in ethanol, clarified with xylene, embedded in paraffin wax and sectioned at 4-5 mm thickness. The sections were stained with hematoxylin and eosin HE and examined under light microscope. Ovarian abnormalities were evaluated and were classified as Follicular cyst or luteal cyst.

Potential economic impact of foetal wastage

Potential economic impact of small ruminant abattoir foetal wastage was roughly estimated by calculating the gross economic value (GEV) and net economic value (NEV) forgone due to loss of potential offspring's as follows-

$$\text{GEV} = (\text{SPI} \times \text{AO} + \text{TPI} \times \text{AO}) \times \text{CTMV}$$

$$\text{NEV} = \text{NPORM} \times \text{CTMV}$$

Where:

SPI = Single Pregnancy Incidence, TPI = Twin Pregnancy Incidence, AO = Annual Off take, CEMV = Current Tanzanian Market Value, and NPORM = Number of Potential Offspring's Reaching Market.

Dodoma Abattoir Weekly Off take (AO) = Average daily off-take (113.6) x Number of weekly working days (7 days) = 795 mature female goats.

Current Tanzanian Market Value (CTMV) of a mature small ruminant estimated to range between 60,000.00 – 100,000.00 Tanzanian shillings, which based on current exchange rates amount to 30 - 50 US \$.

Number of Potential Offspring's Reaching Market (NPORM) was estimated by discounting small ruminant pregnancy loss of up to 14% and lamb/kid mortality loss of up to 18.8% (Assan, 2015) normally anticipated under Tropical conditions.

Histopathology Findings

Data analysis

Data were entered and stored using Microsoft Excel. Chi square test and one way ANOVA were used to assess variations related to categorical and numerical variables using the Stat Calc function on Epi Info™ (Version 7.2, Centers for Disease Control, Atlanta, USA). Descriptive statistics such as the proportion of all slaughters, frequency of pregnant slaughtered goats and the extent of foetal wastage were generated. A value of $p < 0.05$ was considered statistically significant.

Ethics statement

Permission to carry out this study was granted by the Executive Director of Dodoma Municipal. The Vice Chancellor of SUA issued a research permit letter on behalf of the Tanzanian Commission for Science and Technology (COSTECH) that permitted the researcher from the University to conduct research at Dodoma municipal abattoir. Verbal consent was obtained from each of the traded stock owners after explaining the purpose and importance of the study prior to data collection.

RESULTS

Slaughter data

A total of 2869 goats were slaughtered within the 7 active days of observation between 14th and 20th September 2015, representing a daily kills average of 410. Over 72% (n=2074) of the goats slaughtered were male whereas 27% (n=795) were females. The proportions of goats (female and male) and pregnant goats slaughtered are shown in Table 1.

Of the 795 female goats slaughtered, 412 (51.8%) were pregnant, at varied gestation periods. This indicates that at least one out of every two female goats brought to the abattoir for slaughter is likely to be pregnant. Of the total number of foetuses (n=548) encountered during the survey period, 329 (60%) were male and 219 (40%) were female. 136 (17.1%) goats were carrying twins and 34.7% (n=276) carrying singletons. Of the recovered foetuses, CRL measurements ranged from 5 to 35 cm with corresponding gestation length estimated to range from 37 to 103 days. Majority (80%) of foetuses were in second trimester, 12.8% first trimester and minority (7.2%) being in third trimester.

The incidence of ovarian disorders was recorded in 9.6% (37/383) of non-pregnant does. Follicular cysts were observed in 30 cases (7.8%) of non-pregnant does. Grossly, most of the follicular cysts were of a spherical mass bulging from the surface of the ovary, and were filled with a straw coloured serous fluid and occupying a small part of ovarian cortex (Fig. 2). The cysts were thin walled and the wall was either semi-transparent and well vascularized or slightly opaque with little vascularization. Most of follicular cysts (65%) occurred as multiples, of which 52.9% (n=16) were on the right ovary and 47.1% (n=14) were on left ovary. Histologically, the ovum and the surrounding cells were completely degenerated or absent. The granulosa cells were 1-3 layers or completely degenerated in most cases. The basement membrane was not found in most cases and it was difficult to differentiate the theca interna from the theca externa.



Figure 2: Cystic ovarian disease: Follicular cyst (arrow) and uterine wall thickening.

Luteal Cysts were observed singly in either of the ovaries 7 (1.8%) of non-pregnant does. The cysts were thick walled and became opaque with meaty like consistency and grayish yellow in colour (Fig.3). Histologically, the granulosa cells suffered from vaculization and luteinization forming granulosa lutein cells which appeared polyhedral with large vesicular nuclei and vacular cytoplasm. The cysts were surrounded by a fibrous connective capsule.



Figure 3: Ovary, Doe. A Luteal cyst is observed as a smooth yellowish thick-walled mass (arrow) with a fluid-filled cavity in the affected ovary

Potential economic impact of foetal wastage

The gross economic value (GFV) of weekly pregnancy loss at Dodoma abattoir is roughly estimated to 16,440 to 27,400 US \$. Accounting for prenatal pregnancy loss rate of 14% and postnatal lamb/kid mortality rate of 18.8% (Assan, 2015) naturally anticipated under tropical conditions, net weekly economic value (NEV) purely attributed to pregnant slaughter at Dodoma abattoir is estimated at around 8,610 to 14,350 US \$ (17.2 to 28.7 million Tanzanian shillings).

$$\text{GEV} = ((\text{SPI} \times \text{AO}) + (\text{TPI} \times \text{AO})) \times \text{CTMV}$$

$$((34.7\% \times 795) + (17.1\% \times 795 \times 2)) \times 30 \text{ to } 50 \text{ US\$}$$

$$(276 + 272) \times 30 \text{ to } 50 \text{ US\$} = 16,440 \text{ to } 27,400 \text{ US\$}$$

$$\text{NEV} = \text{NPORM} \times \text{CEMV}$$

$$412 \text{ foetus} - 58\% \text{ pregnancy loss rate} - 67 \text{ lamb/kid lost} = 287 \text{ offspring reach market} \times \text{CTMV}$$

$$287 \times 30 \text{ to } 50 \text{ US\$} = 8,610 \text{ to } 14,350 \text{ US\$} (17.2 \text{ to } 28.7 \text{ million Tanzanian shillings}).$$

DISCUSSION

Small ruminants play a significant role in providing food and financial security for rural populations, especially in developing countries. The small size of sheep and goats has distinct economic, managerial, and biological advantages. However, the growth rate of small ruminant production is too slow to cope with the per capita requirements in Tanzania; the human population of Tanzania grows with an estimated 3.0% per year and the livestock resources grow is estimated at 2.5% per year. This phenomenon has attracted huge profits in the meat business, but with the result of undesirable slaughtering of breeding stock and pregnant animals (Nonga, 2015).

The present study revealed that a high number (51.8%; n=412) of slaughtered female goats were pregnant. The results are comparable to the finding by Kheradmand *et al.* (2006) in Iran and Tamirat *et al.* (2015) in Ethiopia. However, our results indicate a higher foetal wastage than the 39% reported in Tanga (Swai *et al.*, 2015), 18 - 20.4% in Ghana (Jarikre *et al.*, 2014; Tasiame *et al.*, 2016) as well as 18- 26% (Bokko, 2011; Alhajiet *et al.*, 2015) reported in Nigeria. The variation between reports and survey could be due to volume of stock slaughtered, location, seasonal and demand of small ruminant meat (Fayemi and Muchenje, 2013). The huge foetal

wastage threatens growth of the livestock industry and therefore undermines government efforts to increase food production.

The pattern of kid wastage observed in this study was 12.8%, 80% and 7.2% in does slaughtered during the first, second and third trimesters of pregnancy, respectively. Similar results were observed elsewhere (Swai *et al.*, 2015; Tamirat *et al.*, 2015; Tasiame *et al.*, 2016). This finding makes the situation more worrisome because pregnancies in the second and third trimesters are more visible and easily detected by simple ballottement even by farmers. This further strengthens the belief that poverty can be a driving factor for livestock keepers who sell their animals to meet house /family needs. Since their poverty level is on the increase, they are usually forced to sell pregnant dams. They also believe that since the pregnant dams would look robust, that will sell at good price fetching them more money. It then further calls for awareness of this menace by owners to reduce the compulsion to sell their pregnant animals, and re-enforcement of ante mortem inspection and legislation against slaughtering of pregnant animals may reduce the number of pregnant brought for slaughter and thus foetal wastage.

A cursory observation of rates of foetal wastages in slaughtered pregnant does across the period shows gross losses in the meat industry with great impact on food security of animal origin. The estimated economic loss of about 1,230 to 2,050 US \$ (2.5 to 4.1 million Tshs) and (8,610 to 14,350 US \$ (17.2 to 28.7 million Tshs) respectively from daily (78 kids) and weekly (548 kids) foetal wastages at Dodoma abattoir alone which could have grown to adult animals if given chance to live. The economic loss is huge resulting in great economic losses to farmers and the country, Tanzania. These economic losses are comparable to an estimated 0.006 to 0.432 billion US dollar per year in Nigeria (Alade *et al.*, 2011; Bokko, 2011; Alhaji and Odetokun, 2013) as well as between 59,460 and 99,100 US \$ in Ethiopia (Tamirat *et al.*, 2015). The prevalence of pregnancy wastage is a major factor exacerbating reproductive wastage in small ruminants and requires overcoming in tropical Africa. Animal owners sell pregnant dams as they fetch higher price. However,

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- there is a need for creating awareness amongst the animal farmers, breeders, meat handlers, quality regulating agencies and consumers about the economic loss occurring following slaughter of pregnant animals.
- Follicular and luteinised cysts are of major clinical significance and constitute the cystic ovarian diseases. In goats; follicles larger than 1.2 cm in diameter are considered cystic (Smith, 1986). In the present study, follicular (7.8%) and luteinized-follicular (1.8%) cysts were found in non-pregnant does. This finding is in agreement with previous studies (Mutebi, 2009; Khodakaram and Davari, 2013). Although the significance of ovarian cysts in small ruminants is not completely understood and has not received as much attention as in cattle, it is a common finding in different breeds of sheep (Dawood, 2010; Palmieri *et al.*, 2011). Cystic ovarian disease has been described mainly among dairy goats especially those grazing oestrogenic pastures (Arthur *et al.*, 1989). Heredity and phosphorous deficiency have also been associated with the condition among goats (Smith, 1986).
- Based on the findings of this study, it is concluded that the prevalence of pregnancy wastage consequent to indiscriminate slaughter of gravid goats at Dodoma abattoir is very high. Slaughter of pregnant does causes the loss of fertile dams that would have actively added kids to the flock as well as the loss of kids that would have replenished the flock. Therefore, effective pregnancy screening before slaughter should be undertaken to reduce losses. In addition, we recommend enforcement of law guiding against the indiscriminate slaughter of pregnant animals to offset substantial financial loss associated with pregnancy wastage at national level.

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