Economic Impact of Hydatidosis and Cysticercosis in Food Animals Slaughtered at Different Abattoirs of Maharashtra

V.M. Vaidya*, R.J. Zende, A.M. Paturkar, Ashok Kumar1 and C.K. Raut

Department of Veterinary Public Health and Epidemiology,
Western Region Referral Laboratory for Meat and Meat Products Quality Standards,
Bombay Veterinary College, Parel, Mumbai-400012

(Received 21.11.2014; accepted 25.01.2015)

ABSTRACT

A study was conducted for a period of one year by post-mortem inspection to estimate the economic impact of hydatidosis and cysticercosis in food animals slaughtered at different abattoirs of Maharashtra. A total of 7311 animals of different species viz. 2637 cattle, 375 buffalo, 1470 sheep, 1009 goat and 1820 pig were inspected. Based on the positivity of hydatidosis and cysticercosis, the economic impact in sampled slaughtered animals was estimated and these estimates were extrapolated at the level of state i.e. Maharashtra. The estimated economic impact based on number of animals slaughtered per year in Maharashtra was found to be Rs. 26,78,721.49 for hydatidosis and Rs. 1,88,310.62 for cysticercosis. It is concluded that both of these diseases are economically important in slaughtered food animals of this state which necessitates the designing of appropriate strategy for prevention and control of these zoonotic diseases.

Keywords: Cysticercosis, economic impact, hydatidosis, slaughter houses, slaughtered animals

Introduction

Parasitic zoonotic diseases like hydatidosis and cysticercosis are responsible for major health problems and they can cause great economic losses in countries where livestock production is a prime segment of the agricultural practice. In livestock sector, it inflicts enormous economic losses due to condemnation of edible organs viz., liver and lung etc. and lowering the quality and quantity of meat (Fromsa and Jobre, 2011). Echinococcosis caused by Echinococcus granulosus is an important zoonotic infection causing morbidity and mortality in humans and significant economic losses in livestock (Daryani et al., 2006; Budke et al., 2006). This multi-host E. granulosus is prevalent all over the world, and annually, the economic impact in livestock due to this parasite is significant (Tappe et al., 2011). Considering the importance of echinococcosis, the World Health Organization and International Epizootic Bureau included this disease in the list of the diseases, which are the subject to radical eradication (Ernest et al., 2009; Getaw et al., 2010; Borji et al., 2012).

Cysticercosis is caused by the larval stage of the tapeworm Taenia solium in pigs and Taenia saginata in cattle. Humans serve as the final host for both Taenia spp., being infected with adult tapeworms (taeniasis). It is a major meat-borne zoonosis and a great economic constraint to the pig industry as well as a serious medical problem. Neurocysticercosis is regarded as the most frequent parasitosis of the central nervous system and the most common cause of epilepsy in India (Pathak and Chabra, 2012). This disease is considered to be one of the most globally important parasitic zoonoses due to its impact on both agriculture and public health as a serious constraint to human and livestock health and productivity. The disease is endemic in developing countries of Latin America, Africa and Asia where it affects the nutritional and economic well-being of poor smallholder farming communities by rendering pork inedible for home consumption.

The prevalence of cysticercosis is found to be higher in developing countries because of poor sanitation, traditional animal husbandry systems and inadequate meat inspection facilities (Cabaret et al., 2002; Dorny and Praet, 2007). As a result, the quality of human life, the aesthetic value of meat and the trading of meat and offal
are compromised (Alum et al., 2010; Dorny and Praet, 2007; Gajadhar et al., 2006). World Health Organization (WHO) estimates that throughout the world at least 50 million people are infected with *Taenia*, which causes annually more than 50,000 deaths (Schantz et al., 1993).

In the above context the present study was planned to assess the economic impact due to organs and meat condemnation because of infection of these parasites in food animals slaughtered at abattoirs.

**Materials and Methods**

The study was carried out in the state of Maharashtra under a ICAR sponsored project entitled, “Outreach Programme on Zoonotic Diseases” in the Department of Veterinary Public Health, Bombay Veterinary College, Parel, Mumbai for a period of one year (April, 2013 to March, 2014) to assess the economic impact of hydatidosis and cysticercosis, which are major causes of organ and meat condemnation of different slaughtered animals. A total of 10 slaughter houses, viz., Deonar abattoir, Mumbai; Kondhawa and Pimpri Chinawad slaughterhouses, Pune; Slaughterhouse of Nagpur Municipal Corporation (MC), Slaughterhouse of Aurangabad MC, Slaughterhouse of Thane MC, Slaughterhouse of Bhiwandi-Nizampur MC, Slaughterhouse of Phaltan, Satara MC, Slaughterhouse of Akola MC and Slaughterhouse of Sangamner, Ahmednagar MC, were covered in the study. A total of 7311 slaughtered animals of different species viz., 2637 cattle, 375 buffaloes, 1470 sheep, 1009 goat and 1820 pigs were inspected. The post-mortem inspection was systematically conducted by a thorough visual inspection, palpation and incision of each visceral organ particularly the lung, liver, kidney, spleen and heart. The carcasses of cattle, buffalo, sheep, goat and pigs were examined for the detection of hydatid cysts. As per the procedure of Getaw et al. (2010), the hydatid infected organs from each positive animal were collected (Fig.1 and 2). The total number of hydatid cysts were counted per infected organ and recorded. Similarly, deep incisions were taken at common predilection areas/sites such as shoulder muscle, thigh muscle, masseter muscle, neck, diaphragm, liver and heart to detect the cysticerci.

In case of hydatidosis and cysticercosis infection, economic loss due to condemnation of organs was calculated by multiplying the weight of condemned organs from slaughtered animals with their current market prices. Data regarding the prevailing price of organ (per kg) was obtained by conducting a survey of 10 randomly selected meat sellers. The average price per organ was then obtained, which was used to calculate the economic loss by using following formula:

\[
\text{Total economic loss} = \frac{\text{Weight of condemned organ/viscera (kg) \times prevailing price of visceral organ (Rs/Kg)}}{}
\]

The economic loss accruing from body weight loss due to hydatidosis and cysticercosis was estimated on the basis of estimate of live body weight loss due to these infections as given by Polydorou (1981), which is loss of 5% of body weight.

Based on the estimate of economic losses in the sampled slaughtered animals, as obtained in this study, an attempt was made to extrapolate the economic losses to the state level due to these diseases. The average economic loss per infected slaughtered animal as obtained in this study was imputed on the number of infected animals slaughtered out of total animal slaughtered annually in Maharashtra.

The number of animals slaughtered per year in Maharashtra, species wise, was obtained by multiplying the population of different species as reported in Integrated Survey Scheme Report on Milk, Egg, Wool & Meat Production in Maharashtra State for the year 2008-09 (Department of Animal Husbandry, Government of Maharashtra (India), 2014). The species wise number of animals slaughtered in Maharashtra viz., 5,11,421 cattle, 7,03,115 buffalo, 75, 79, 021 sheep & goats and 2,18,404 pigs.

The number of infected animals slaughtered was then obtained by multiplying the prevalence rate of the two infections as observed in the study in the sampled slaughtered animals on the total number of animals slaughtered annually in the Maharashtra.

**Results**

**Economic impact due to Hydatidosis in sampled slaughtered animals**

A total of 7311 slaughtered animals of different species viz., 2637 cattle, 375 buffaloes, 1470 sheep, 1009 goat and 1820 pigs were inspected. The average prices of different organs as obtained from survey of meat sellers are presented in Table 1. On the basis of number of positive samples, the total economic impact due to hydatidosis from condemnation of organs was found to be Rs. 30, 880; Rs. 2,619 and Rs. 3,440 in cattle and buffalo, pig, and sheep and goat, respectively (Table 2). Based upon the assumption of 5% weight loss due to hydatidosis, the economic loss due to loss in body weight was observed to be Rs.1,86,750 in cattle and buffalo; Rs. 9, 310 in pig and Rs. 4,680 in sheep and goat (Table 3). Thus, the total economic impact in cattle and buffalo was Rs. 2,17,630; pig and sheep and goat was Rs. 2,17,630; Rs. 11,929 and Rs. 8,120, respectively (Table 3). Therefore, the total economic impact due to hydatidosis for all slaughtered animals was estimated to be Rs. 2,37,679. The above results thus revealed that the economic impact of hydatidosis was substantially higher in cattle and buffalo as compared to...
Table 1. Local price of organs and meat of slaughtered animals

<table>
<thead>
<tr>
<th>Organ</th>
<th>Cattle/buffalo</th>
<th>Pig</th>
<th>Sheep/goat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver (Rs. per kg)</td>
<td>180</td>
<td>140</td>
<td>360</td>
</tr>
<tr>
<td>Lung (Rs. per kg)</td>
<td>80</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Spleen (Rs. per kg)</td>
<td>40</td>
<td>30</td>
<td>90</td>
</tr>
<tr>
<td>Heart (Rs. per kg)</td>
<td>180</td>
<td>140</td>
<td>360</td>
</tr>
<tr>
<td>Meat (Rs. per kg)</td>
<td>180</td>
<td>140</td>
<td>360</td>
</tr>
</tbody>
</table>

Table 2. Slaughtered animal species wise economic impact of hydatidosis

| Organ     | Animal species | Cattle/buffalo | Pig       | Sheep/goat |
|-----------|----------------|----------------|-----------|
| Liver     | Cattle/buffalo | 36             | 8         | 9          |
|           | Pig            | 47             | 5         | 4          |
| Spleen    | Cattle/buffalo | 4              | 2         | -          |
|           | Pig            | -              | 4         | -          |
| Heart     | -              | -              | 4         | -          |
| Total (Rs.) | 30880         | 2619          | 3440      |

*Weight per liver, lung, spleen and heart of cattle considered as 3kg, 3 kg, 1kg and 1kg respectively; *Weight per liver, lung, spleen and heart of pig considered as 2 kg, 0.5 kg, 0.5 kg and 0.4 kg respectively; *Weight per liver, lung, spleen and heart of sheep considered as 1 kg, 0.5 kg, 0.3 kg and 0.3 kg respectively.

Table 3. Total economic impact in slaughtered animals due to hydatidosis

<table>
<thead>
<tr>
<th>Animal species</th>
<th>Avg. weight per animal (1)</th>
<th>Average Price per kg in Rs. (2)</th>
<th>Economic loss due to weight loss per animal (3) (Rs)</th>
<th>Economic loss due to weight loss per animal (2x3) (4) (Rs)</th>
<th>Total number of animals infected with hydatidosis (5)</th>
<th>Economic loss due to weight loss in animals (Rs.) (5x4) (6) (Rs)</th>
<th>Economic loss due to organ loss in animals (Rs.) (7) (7)</th>
<th>Total economic loss due to hydatidosis in animals (Rs.) (8) (6+7) (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle/buffalo</td>
<td>250</td>
<td>12.5</td>
<td>180</td>
<td>2250</td>
<td>83</td>
<td>1,86,750</td>
<td>30,880</td>
<td>2,17,630</td>
</tr>
<tr>
<td>Pig</td>
<td>70</td>
<td>3.5</td>
<td>140</td>
<td>490</td>
<td>19</td>
<td>9,310</td>
<td>1,57,360</td>
<td></td>
</tr>
<tr>
<td>Sheep/goat</td>
<td>20</td>
<td>1</td>
<td>360</td>
<td>360</td>
<td>13</td>
<td>4,680</td>
<td></td>
<td>8,120</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,00,740</td>
<td>36,939</td>
<td>2,37,679</td>
</tr>
</tbody>
</table>

Table 4. Slaughtered animal species wise economic impact of cysticercosis

<table>
<thead>
<tr>
<th>Organ/ carcass</th>
<th>Animal species</th>
<th>Cattle</th>
<th>Buffalo</th>
<th>Pig</th>
<th>Sheep/goat</th>
<th>Economic loss (price per kg x number of infected organs x weight per organ*) (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>Cattle</td>
<td>9</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>180x9x3= 4,860</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>140x2x2=560</td>
</tr>
<tr>
<td></td>
<td>Pig</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>140x16x70= 1,56,80</td>
</tr>
<tr>
<td>Whole carcass</td>
<td>Cattle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pig</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total (Rs.)</td>
<td></td>
<td>4,860</td>
<td>1,57,360</td>
<td></td>
<td></td>
<td>Total economic loss due to Cysticercosis during the year 2013-14 is (4860+157360)= Rs. 1,62,220</td>
</tr>
</tbody>
</table>

*Weight of pig is considered as 70 kg @ 140 Rs. per kg; *Weight of cattle liver is considered as 3 kg @ 180 Rs. per kg
pig and sheep and goat. The prevalence rates were estimated for hydatidosis in sampled slaughtered animals and it was found to be 2.75% in bovine, 0.52% in sheep and goats and 1.04% in pigs. Based on these observations, the total number of 33,400 bovines, 39,411 sheep and goats and 2272 pigs found to be infected annually in Maharashtra with hydatidosis (Table 5).

### Projected economic impact due to hydatidosis based on number of animals slaughtered per year in Maharashtra

The projected economic impact per year in Maharashtra due to hydatidosis based on the number of animals slaughtered is estimated to be Rs. 24,13,150 and Rs. 2,58,142.05 in cattle and pigs, respectively (Table 4). The total economic impact due to whole carcass loss in pig was found to be Rs.1,56,800. Thus, total economic loss in cattle and pig was Rs. 4,860 and Rs. 1,57,360, respectively. The total economic loss due to cysticercosis of all the slaughtered animals was estimated to be Rs. 1,62,220 (Table 4). The prevalence rates estimated for cysticercosis in sampled slaughtered animals were 0.34% in cattle and 0.98% in pigs. Based on the percent prevalence, annually in Maharashtra total number of 1739 cattle and 2141 pigs found to be infected with cysticercosis (Table 6).
Projected economic impact due to cysticercosis based on number of animals slaughtered per year in Maharashtra

The projected economic impact per year in Maharashtra due to cysticercosis based on the number of animals slaughtered is estimated to be Rs. 3,199,76 and Rs. 1,85,110.86 in cattle and pig, respectively. Therefore, the total loss per year in Maharashtra due to cysticercosis = Rs. 1,88,310.62 (Table 6).

Discussion

The present study has analyzed the economic impact of hydatidosis and cysticercosis in different food animals slaughtered at various abattoirs of Maharashtra. Literature review had revealed that there is scarcity of information regarding systematic evaluation of the economic impact due to these two parasitic diseases in Maharashtra as well as India. However, literature from other developing countries documenting annual economic losses due to bovine hydatidosis is available. Getaw et al. (2010) estimated the total economic loss due to hydatidosis by summatng cost of offal condemned and the cost of carcass weight losses. Our findings are in accordance with the findings of Bizuwork et al. (2013), who estimated a financial loss 302,023.60 ETB per year to the beef industry in Ethiopia due to hydatidosis. Endalew and Nuraddiis (2013) reported the total annual economic loss due to bovine hydatidosis from organ condemnation and carcass weight loss at Gondar Elfora abattoir at 674,093.038 ETB. Alemu and Yitagele (2013) estimated the annual economic loss from organ condemnation and carcass weight reduction to be $21,833.60. Dechassa et al. (2012) reported a financial loss of 19,847,704.5 ETB from organ condemnation due to bovine hydatidosis at Addis Ababa Abattoir Enterprise. According to Melaku et al. (2012) a significant financial loss was registered due to hydatidosis at Dessie municipal abattoir, Ethiopia with an estimated loss of 681,333.87 ETB which is about 39,157.12 United States dollars (USD) per annum. Mulatu et al. (2013) estimated the financial loss of $23,876 due to hydatidosis in Dire Dawa municipal abattoir, Ethiopia during the six months period of study, which appears to be a significant loss.

The difference in the amounts of estimates of economic loss, as reported in the above studies, could be due to the variation in the prevalence of the hydatidosis, retail market price of organs and mean annual slaughter rate in different abattoirs. In the present study, condemnation of liver was found to be major cause of total economic loss as compared to other organs i.e., lung, spleen and heart (Table 2). Similar finding was also noted by Melaku et al. (2012) and observed that the hydatid cysts were predominantly found in lungs and liver compared to other organs.

The findings of the present study pertaining to economic losses due to cysticercosis are in accordance with the findings of earlier workers. Pathak and Gaur (1990) reported a loss of Rs. 64,600 due to 3.8% infection in pigs. D’ Souza and Hafeez (1998) reported economic loss of Rs. 2,61,661 due to 4.22% infection in an organised abattoir in Andhra Pradesh. Praet et al. (2009) reported a loss 10,255,202 Euro due to cysticercosis in West Cameroon, out of which 4.7% was accounted for by loss in pig husbandry and remaining 95.3% by direct and indirect losses caused by human cysticercosis. Zoli et al. (2003) calculated the annual economic losses due to cysticercosis in Cameroon at 2,062,125 Euro.

The present study has revealed that the parasitic zoonotic diseases such as hydatidosis and cysticercosis are prevalent in different area of Maharashtra and causes significant economic losses through organ condemnation and body weight loss. Also, there is a wide difference in the estimated economic losses in the abattoirs which is majorly due to variation of the number of slaughtered animals or variation in the age and sex of the slaughtered animals. Although, effective and reliable tools for the diagnosis, prevention and control of these diseases are available now, their implementation has not always been successful in many countries including India. This is primarily due to the lack of awareness on the presence or impact of the disease causing parasites (T. saginata, T. solium, and Echinococcus spp). Therefore, proper meat inspection and disposal of condemned organs and meat are essential to reduce the financial losses and safeguard the public. In addition to this, the construction of well equipped abattoirs and enhancement of awareness of people about the economic and public health importance of these diseases are also crucial.

Acknowledgements

The authors thank the Indian council of Agricultural Research, New Delhi, for financial assistance provided under the sponsored project “Outreach Programme on Zoonotic Diseases” for this work.

References


