

Original

Viscera seizure due to fascioliasis and cystic echinococcosis in cattle, sheep and goats slaughtered in Apurímac, Peru

Yerlid Carrión-Ascarza¹  MVZ; Renzo Bustinza-Cardenas²  MVZ;
Aldo Valderrama-Pomé^{1*}  Ph.D.

¹Universidad Nacional Micaela Bastidas de Apurímac, Facultad de Medicina Veterinaria y Zootecnia, Patibamba Baja s/n, Abancay, Perú.

²Municipalidad Provincial de Abancay, Perú.

*Correspondencia: alimvalderrama@gmail.com

Received: July 2020; Accepted: December 2020; Published: March 2021.

ABSTRACT

Objective. To determine the percentage of infection of fascioliasis and cystic echinococcosis; also, the impact of the seizure of viscera in ruminants slaughtered in the municipal slaughterhouse of Abancay, Peru. **Materials and methods.** The study was basic, cross-sectional, and analytical. It included all the ruminants slaughtered in the slaughterhouse, from September to December 2012. The live weight of the ruminants was determined, in addition to the weight of their healthy and infected viscera. The economic loss for the seizure of viscera was estimated. The data analysis was performed using the Excel Windows 2010 program and the MINITAB version 17 statistical package. The Chi-square test was used to determine differences between proportions and the t test for equality of means, using a confidence level of 95 %. **Results.** The percentage of infection with fascioliasis was 79.6% (95% CI = 77.7-81.6) in cattle, 53.2% (95% CI = 48.9-57.4) in sheep, and 21% (95% CI = 16.1-25.8) in goats. The percentage of infection with cystic echinococcosis was 5.4% (95% CI = 4.3-6.6) in cattle, 16.7% (95% CI = 13.5-19.7) in sheep and 12.4% (95% CI = 8.4-16.3) in goats. The economic loss in the study season was USD 16,507.46. **Conclusions.** The presence of liver fluke affects the weight of the livers in cattle and sheep; in addition, the hydatid cyst affects the weight of the liver in all ruminants studied and affects the weight of the lungs in sheep and goats. The greatest economic loss was due to seizure of livers due to fascioliasis, especially in cattle.

Keywords: Carcass seizure; liver fluke; echinococcosis; ruminants; viscera (Sources: DeCs, CAB).

RESUMEN

Objetivo. Determinar el porcentaje de fascioliasis y equinococosis quística; también, el impacto del comiso de vísceras en rumiantes faenados en el matadero municipal de Abancay, Perú. **Materiales y métodos.** El estudio fue básico, transversal y analítico. Se incluyeron todos los rumiantes faenados en el matadero, de septiembre a diciembre de 2012. Se determinó el peso vivo de los rumiantes, además del peso de sus vísceras sanas e infectadas. Se estimó la pérdida económica por la incautación

How to cite (Vancouver).

Carrión-Ascarza YP, Bustinza-Cardenas RH, Valderrama-Pomé AA. Viscera seizure due to fascioliasis and cystic echinococcosis in cattle, sheep and goats slaughtered in Apurímac, Peru. Rev MVZ Córdoba. 2021; 26(2):e2056. <https://doi.org/10.21897/rmvz.2056>



©The Author(s), Journal MVZ Córdoba 2021. This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<https://creativecommons.org/licenses/by-nc-sa/4.0/>), lets others remix, tweak, and build upon your work non-commercially, as long as they credit you and license their new creations under the identical terms.

de vísceras. El análisis de los datos se realizó con el programa Excel Windows 2010 y el paquete estadístico MINITAB versión 17. Se utilizó la prueba de Chi-cuadrado para determinar diferencias entre proporciones y la prueba t de igualdad de medias, utilizando un nivel de confianza del 95%. **Resultados.** El porcentaje de infección por fascioliasis fue 79.6% (IC 95% = 77.7-81.6) en bovinos, 53.2% (IC 95% = 48.9-57.4) en ovejas y 21% (IC 95% = 16.1-25.8) en cabras. El porcentaje de infección por equinococosis quística fue 5,4% (IC 95% = 4.3-6.6) en bovinos, 16.7% (IC 95% = 13.5-19.7) en ovejas y 12.4% (IC 95% = 8.4-16.3) en cabras. La pérdida económica en la temporada de estudio fue de USD 16.507,46. **Conclusiones.** La presencia de duela hepática afecta el peso de los hígados en bovinos y ovinos. El quiste hidatídico afecta el peso del hígado en todos los rumiantes estudiados y afecta el peso de los pulmones en ovejas y cabras. La mayor pérdida económica se debió al comiso de hígados debido a la fascioliasis.

Palabras clave: Decomiso de la canal; *Fasciola hepática*; equinococosis; rumiantes; vísceras (Fuentes: DeCs, CAB).

INTRODUCTION

Fascioliasis and cystic echinococcosis are cosmopolitan parasitic zoonotic diseases that present high prevalence rates in animals and humans, especially in countries with restricted economic progress (1).

Fascioliasis is produced by the adult stage of the flatworm fluke, liver fluke, whose definitive hosts are ruminants; in addition, humans as accidental host, who become infected by ingesting the metacercaria (larval stage), which are found in grass, herbs or aquatic plants that carry the larvae attached to their extension (1,2). In this regard, infection has been reported in cattle, sheep and goats, between 0.1-38% in Greece, Iran and Ethiopia (3,4,5,6); as well as 0.6-41.5% in countries of the American continent (7,8,9,10,11,12,13,14) and 38.2-59.5% in Peru (15,16,17).

On the other hand, cystic echinococcosis is caused by the larvae of the cestode *Echinococcus Granulosus*; which is in the intestine of canids (definitive host). Canids eliminate the cestode eggs in the excreta, contaminating the food of ruminants and humans. When they become infected, the larvae develop especially in their liver or lungs (1,18). Thus, there are reports of infection by cystic echinococcosis in cattle, sheep and goats between 0.2-22% in Egypt, Iran, and Ethiopia (6,19); as well as 12.4% in Chile (20) and 2.6-6.5% in Peru (21).

The seizure of viscera not suitable for human consumption is important to guarantee the safety and quality of food. In the slaughterhouse, the resulting carcass, meat, and offal may contain

pathogenic or parasitic microorganisms and present various alterations; This is detected at the time of *post-mortem* inspection, and it is about diseases or processes that the animal already suffered before being slaughtered (22).

It follows that the economic losses are very high in livestock production, which contributes to the detriment of the development of the populations dedicated to this activity; therefore, infected viscera must be discarded, according to the type of disease involved. So much so that, in some Asian countries, due to the seizure of viscera, losses of more than USD 1,000 per month have been reported (4) and in South America, greater than USD 6,000 per month (10).

In Peru, these parasitic zoonoses are of relevant importance for public health and the economy (8,21). However, it is difficult to estimate the negative economic impact due to the seizure of viscera due to parasitosis in animal production due to the scarce information in the different regions of Peru. The reports of the National Agrarian Health Service indicate that approximately 24.2% of the viscera are seized annually in the slaughterhouses of the country, where the highest prevalence of seizures occurs in Apurímac (80.1%) (1).

Because the raising of cattle, sheep and goats constitutes an important economic activity in the agricultural sector of the region, as well as a cheap food source for man due to the contribution of nutrients, among which are the consumption of viscera, the percentage of infection of fascioliasis and cystic echinococcosis was determined; as well as, the impact of the seizure of viscera in ruminants slaughtered in the municipal slaughterhouse of Abancay.

MATERIALS AND METHODS

Type of Study. The study was basic, cross-sectional, and analytical.

Study Site. The study was carried out in the municipal slaughterhouse of the province of Abancay, capital of the Apurimac region, in which ruminants from the Apurimac region and other regions of the country are slaughtered (Figure 1). Abancay is located at 13°22'55" South longitude and 72°24'01" West latitude, at an altitude of 2378 m (23).

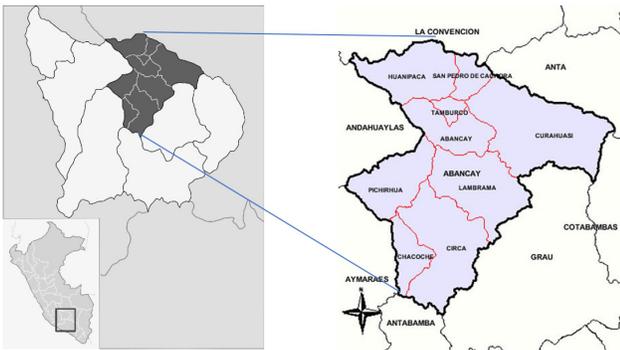


Figure 1. Origin of cattle, sheep and goats slaughtered in the slaughterhouse of the province of Abancay, Apurimac region, Peru.

Geoclimatic conditions. The climate of Abancay is temperate, moderately rainy and with moderate thermal amplitude. The annual mean maximum and minimum temperature is 24.9°C and the minimum is 8.6°C, respectively. The mean annual accumulated precipitation is 595.6 mm (23).

Study Animals. The totality of animals slaughtered in the slaughterhouse during the months of September to December 2012 was studied, corresponding to 1674 cattle, 551 sheep and 291 goats. It is worth mentioning that all the animals were Creoles.

Laboratory methods. The weight of the ruminants was collected from the records collected by the slaughterhouse administrative staff, who used a digital scale to weigh sheep and goats; as well as a measuring tape for the size-weight conversion in cattle. The weight of the viscera was also obtained with a digital scale. Likewise, from the slaughterhouse records the inspection of red viscera (liver and

lungs) was obtained. With this information, the percentage of infection by fascioliasis and cystic echinococcosis was calculated using the following formula:

$$\text{Percentage of infection} = (\text{affected animals} / \text{benefited animals}) \times 100$$

The assessment of the economic loss was estimated with the average weight of the healthy viscera of the animal, considering that the cost of the liver was 2.86 USD/kg and that of the lungs 1.43 USD/kg, using the following formula:

$$\text{PE} = N \times \text{PV} \times \text{PrH} \text{ (kg)}$$

Where:

PE = Economic loss

N = Total seized viscera

PV = Average weight of the viscera

PrH (kg) = Price per kilogram of liver (USD 2.86)

PrP (kg) = Price per kilogram of lung (USD 1.43)

Analysis of Results. For the tabulation and analysis of the data, the Excel Windows 2010 program and the MINITAB version 17 statistical package were used with the Chi-

square test (χ^2) to determine significant differences between proportions and the t test for equality of means, using a level 95% confidence.

RESULTS

Percentage of infection. Table 1 shows that the percentage of infection with fascioliasis was 79.6% (95% CI = 77.7-81.6) in cattle, 53.2% (95% CI = 48.9-57.4) in sheep and 21% in goats (95% CI = 16.1-25.8). Likewise, the percentage of infection with cystic echinococcosis was 5.4% (95% CI = 4.3-6.6) in cattle, 16.7% in sheep (95% CI = 13.5-19.7) and 12.4% in goats (95% CI = 8.4-16.3).

On the other hand, age was associated with fascioliasis in cattle ($p < 0.05$) and sheep ($p < 0.01$); as well as cystic echinococcosis in cattle ($p < 0.05$); therefore, the percentage of infection increases with age. In addition, sex was associated with cystic echinococcosis in cattle ($p < 0.01$), since females presented a higher percentage of infection.

Table 1. Percentage of infection with fascioliasis and cystic echinococcosis in cattle, sheep, and goats of the Apurimac region.

DF	Cattle		Sheep		Goats	
	F (%)	Eq (%)	F (%)	Eq (%)	F (%)	Eq (%)
Age (teeth)						
DL	110 (72.4)	4 (2.6)	20 (39.2)	10 (19.6)	2 (6.7)	4 (13.3)
2	213 (80.1)	13 (4.9)	72 (59.0)	19 (15.6)	10 (24.4)	4 (9.8)
4	144 (75.0)	6 (3.1)	41 (36.6)	24 (21.4)	11 (22.4)	4 (8.2)
6	151 (80.3)	7 (3.7)	41 (60.3)	10 (14.7)	5 (13.9)	3 (8.3)
BLL	715 (81.6)	61 (7.0)	119 (60.1)	29 (14.6)	33 (24.4)	21 (15.6)
Sex						
Male	493 (77.9)	16 (2.5)	127 (56.4)	36 (16.0)	24 (19.7)	17 (13.9)
Female	840 (80.7)	75 (7.2)	166 (50.9)	56 (17.2)	37 (21.9)	19 (11.2)
Total	1,333 (79.6)	91 (5.4)	293 (53.2)	92 (16.7)	61 (21.0)	36 (12.4)

DF= Demographic factors; F = Fascioliasis; Eq = Cystic echinococcosis; DL = Milk teeth; BLL = Mouth full

Figure 2 shows that the origin of the cattle with fascioliasis did not show a significant statistical difference ($\chi^2 = 5.37284$; $p = 0.615$). However, the cattle with the highest percentage of infection with cystic echinococcosis came from the Puerto Maldonado region ($\chi^2 = 35.7296$; $p = 0.000$). It is worth mentioning that it was possible to identify the origin of the cattle through the internal transit document issued by the National Agrarian Health Service and/or municipal authorities. However, it was not possible to identify the origin of the sheep and goats due to the fact that they are acquired and traded irregularly in the region; which, for their slaughter, require an affidavit of purchase and sale that does not specify the origin of the animal.

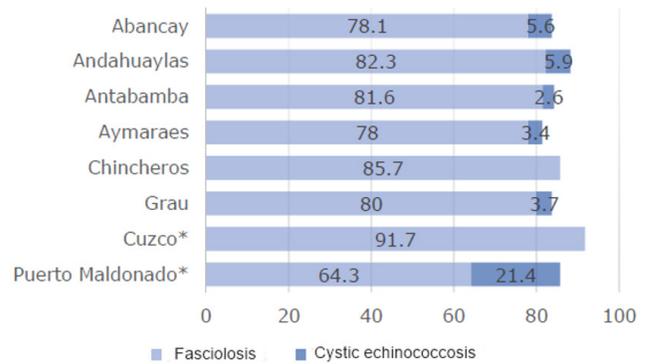


Figure 2. Percentage of infection with fascioliasis ($p > 0.05$) and cystic echinococcosis ($p < 0.01$) in cattle, according to the province of origin. * Cattle from other regions.

Visceral location of the parasitosis. Table 2 shows that hepatic fascioliasis was found not only in the liver; but also, although to a lesser extent, in the lungs of cattle and sheep ($p < 0.01$). Likewise, the visceral location of the hydatid cyst was preferentially pulmonary in cattle; and hepatic in sheep and goats ($p < 0.01$).

Table 2. Percentage of infection by fascioliasis and cystic echinococcosis in the viscera of cattle, sheep, and goats of the Apurimac region.

Species	Fascioliasis		
	H (%)	P (%)	HP (%)
Cattle	^a 1,230 (92.3)	3 (0.2)	100 (7.5)
Sheep	^a 288 (98.3)	3 (1.0)	2 (0.7)
Goats	61 (100.0)	-	-
Cystic Echinococcosis			
Cattle	21 (23.1)	^a 60 (65.9)	10 (11.0)
Sheep	^a 67 (72.8)	13 (14.1)	12 (13.0)
Goats	^a 25 (69.4)	6 (16.7)	4 (11.1)

H = Liver; P = lungs; HP = Liver and lung; ^a($p < 0.01$).

Weight of parasitized viscera. Table 3 shows that, according to the t-test for equality of means, the average weight of the livers with liver fluke in cattle and sheep was higher by 0.7 kg and 0.2 kg, respectively, than in healthy livers ($p < 0.01$). However, the average liver weight in goats showed no difference ($p < 0.05$).

Table 3. Weight (kg) of healthy liver infected with liver fluke or hydatid cyst in cattle, sheep, and goats in the Apurimac region.

Species	Healthy liver	Liver with / liver fluke		Liver with hydatid cyst			
	Mean	Mean	DM	IC95%	Mean	DM	IC95%
Cattle	3.3	3.2	^a 0.7	0.6;0.9	3.9	^a 0.7	0.3;1.1
Sheep	0.5	0.7	^a 0.2	0.1;0.2	0.7	^a 0.2	0.1;0.2
Goats	0.6	0.7	0.0	-0.0;0.1	0.8	^a 0.1	0.1;0.2

DM = means difference; ^a($p < 0.01$).

On the other hand, the average weight of the livers with hydatid cyst in cattle, sheep and goats was higher in 0.7 kg, 0.2 kg, and 0.1 kg, respectively, to healthy livers ($p < 0.01$).

Table 4 shows that the average weight of the lungs with liver fluke of cattle and sheep did not show a difference with the weight of healthy lungs ($p > 0.05$). It was not possible to estimate

the difference in weight in goats because no animal had liver fluke in the lungs.

On the other hand, the average weight of the lungs with hydatid cyst in sheep and goats was greater by 0.2 kg ($p < 0.01$ and $p < 0.05$, respectively), than in healthy lungs. But the weight of the lungs with liver fluke in cattle showed no difference with the weight of the healthy lungs ($p < 0.05$).

Table 4. Weight (Kg) of healthy lungs infected with liver fluke or hydatid cyst in cattle, sheep, and goats in the Apurímac region.

Species	Healthy lung	Liver with / liver fluke			Liver with hydatid cyst		
	Mean	Mean	DM	IC (95%)	Mean	DM	IC (95%)
Cattle	2.4	2.2	-0.2	-0.7;0.4	2.5	0.2	0.4;0.7
Sheep	0.6	0.6	-0.0	-0.5;0.4	0.8	^a 0.2	0.1;0.3
Goats	0.7	-	-	-	0.9	^b 0.2	0.1;0.4

DM = means difference; ^a($p < 0.01$); ^b($p < 0.05$)

Live weight of infected ruminants. Table 5 shows that the live weight of the ruminants infected with liver fluke, according to the visceral location, did not show a statistically significant difference with the live weight of healthy animals ($p < 0.05$).

Table 6 shows that the live weight of the ruminants infected with cystic echinococcosis, according to the visceral location, did not show a statistically significant difference with the live weight of healthy animals ($p < 0.05$).

Table 5. Live weight (kg) of healthy ruminants infected with fascioliasis according to the visceral location of the parasite.

Ruminant	Healthy PV	PV Fascioliasis H	PV Fascioliasis P		PV Fascioliasis HP		
	Mean	Mean	DM	Mean	DM	Mean	DM
Cattle	284.0	290.0	5.6	277.9	-6.0	290.0	5.8
Sheep	25.7	26.2	0.5	25.6	0.1	25.5	-0.2
Goats	27.3	28.1	0.9	-	-	-	-

PV = Live Weight; H = Liver; P = Lung; HP = Liver and lung; DM = means difference.

Table 6. Live weight (kg) of healthy ruminants infected with cystic echinococcosis according to the visceral location of the cyst.

Ruminant	Healthy PV	PV cystic echinococcosis H	PV cystic echinococcosis P		PV cystic echinococcosis HP		
	Mean	Mean	DM	Mean	DM	Mean	DM
Cattle	284.0	363.0	78.6	270.0	-14.0	310.0	26.3
Sheep	25.7	25.7	-0.0	24.5	-1.2	25.1	-0.6
Goats	27.3	28.6	1.3	49.5	2.2	26.9	-0.3

PV = Live Weight; H = Liver; P = Lung; HP = Liver and lung; DM = means difference.

Economic loss. Table 7 shows that the greatest economic loss due to liver seizure occurred due to fascioliasis, especially in cattle. Therefore,

the total economic loss in the study season was USD 16,507.46.

Table 7. Economic loss due to seizure of viscera of ruminants with fascioliasis and cystic echinococcosis in the Apurimac region.

Ruminant	Liver				Lung				Total Loss (\$)
	F (n)	Loss (\$)	Eq (n)	Loss (\$)	F (n)	Loss (\$)	Eq (n)	Loss (\$)	
Cattle	1.330	12.153.14	31	283.27	103	397.68	70	236.44	13.070.53
Sheep	292	2.668.21	79	114.78	3	10.13	25	23.02	2816.14
Goats	61	557.40	30	53.11	-	-	11	10.27	620.78
Total	1.683	15.378.75	140	451.16	106	407.82	106	269.73	16.507.46

F = Liver fluke; Eq = Cystic echinococcosis; \$ = US Dollars

DISCUSSION

Percentage of infection. The percentage of fascioliasis infection in cattle (79.6%) was quite high, higher than that reported in other Peruvian regions (5,15,17) and in many countries around the world (3,4,6,7,8, 9,10,11,12,13,14). In the same way, the percentage of fascioliasis infection in sheep (53.2%) and goats (21%) was also very high, higher than that reported in other countries (3,4,5), only lower than that found in goats of Ethiopia (6).

There is very little history of erratic liver fluke in animals, as it was found in the lungs of cattle (7.7%) and sheep (1.7%) in this study; However, in some hyperendemic areas of Peru this presentation is common, as in the Cajamarca region where 1.1-3.7% were found in cattle (24). Other studies in people reported that in Spain 2 of 20 patients with fascioliasis had an ectopic presentation (25); as well as 7 of 277 patients in Peru (24). Erratic migration of the liver fluke to the lungs and other organs has been demonstrated, because when immature flukes cross the duodenum, they do not eventually reach the liver capsule, but continue to cross the peritoneum, fascia, and muscle layer of abdominal wall (26,27).

Consequently, the Apurimac region classifies as a hyperendemic zone for fascioliasis in cattle and sheep because it exceeds the 50% infection range (2). These high percentages of fascioliasis are probably due to the fact that in the region the raising of animals is mostly extensive and for self-consumption, since the breeders are not used to deworming their animals, due to the high economic cost that it represents and due to lack of knowledge about of the sanitary control that parenting implies. Likewise, the climatic characteristics of the area are favorable for the disease to develop.

The percentage of infection by cystic echinococcosis in cattle (5.4%) was moderate, like that of Huancarama (21), located in the same region; but lower than that found in other countries (6,19,20). However, the percentage of infection by cystic echinococcosis in sheep and goats was high (16.7% and 12.4%, respectively), only lower than reports in Ethiopia (6).

The percentage of infection by hydatid cyst in bovine livers in the study (23.1%) was only similar to reports in Ethiopia (28); since it was higher than that found in other countries (3,5,12,14,20,29). Likewise, the percentage of infection in sheep livers (72.8%) was much higher than that found in Junín in Peru (30) and in other countries (3.5). Similarly, in goats (69.4%) it was higher than that found in distant countries (3.31).

The percentage of infection by hydatid cyst in the lungs of cattle in the study (65.9%) was high, similar to that found in Ethiopia (28) and Chile (14,20) and Argentina (29), much higher than that reported in Iran (8) and Greece (3). However, the infection in the lungs of sheep (14.1%) was low, lower than that found in Junín (30) in Peru, Greece (3) and Iran (5). Similarly, the percentage of infection in goat lungs (16.7%) was higher than that found in Greece (3).

The percentage of infection by hydatid cyst in liver and lungs (mixed infection) of cattle in the study (11%) was low; lower than that reported in Junín in Peru (30), Argentina (29) and Chile (14,20).

As can be seen, the percentage of infection by cystic echinococcosis in cattle, sheep and goats was high, probably since the breeders of these animals in the region show poor knowledge and preventive practices (21). In addition,

the nutritional conditions of the animals, the hygienic environments of the slaughterhouses, the method of slaughter, the weather conditions and the infection rate of the dogs could have an impact (18).

Weight of parasitized viscera. During the initial period of fascioliasis, young worms, moving through the peritoneum and the liver parenchyma, cause a tissue reaction to a foreign body, causing inflammation of the peritoneum with exudate and leukocyte infiltrate of eosinophils, mainly; the liver grows and presents necrosis and micro abscesses (32). However, when the parasites are in the bile ducts, they dilate by sclerosing, fibrosing and chronically inflaming around them. Likewise, the epithelium usually presents pseudo glandular hyperplasia. Furthermore, when the number of parasites is high, the liver parenchyma becomes ankyloses due to pressure and periportal cirrhosis; consequently, the hepatic lobes show increased consistency,

thickening of the hepatic ducts with the presence of calcification, mucous material, and adult forms of the parasite (33); which increases the volume and weight of the parasitized liver (26). However, when the liver fluke is located in the lung, regular thickening of the pleura with a non-inflammatory appearance is observed, with no other apparent alterations; that, unlike the hepatic location, decreases the weight of the lung in cattle. Therefore, the weight of viscera with hydatid cyst increased significantly, probably due to the high size and quantity of cysts that the ruminant species studied usually present (30).

Live weight of infected ruminants. The research showed that the live weight of ruminants with fascioliasis and cystic echinococcosis was not different from the live weight of healthy animals. This is since the infectious process of both parasitosis is progressive, and may even take several years, which, added to the rusticity typical of Creole animals, would not affect live weight. So much so that 65% of the cattle in Peru

is classified as "Creole", denoting that animal that descends from crosses of autochthonous breeds originating from the South of Spain, which over the years have developed adaptation peculiarities that have allowed it to survive and producing in the rustic contexts of the Peruvian geography (34).

Economic loss. 85.9% of the economic loss corresponds to the seizure of cattle liver; consequently, the monthly loss due to the seizure of viscera at the Abancay slaughterhouse was estimated at USD 4,126.87; only comparable with reports from Colombia (10) and Costa Rica (13); However, other slaughterhouses reported much lower monthly losses, such as Paraguay (7), Cuba (11), Greece (3) and Iran (4). These differences are due to inequalities in the slaughter and handling processes of the animals, carried out in each slaughterhouse, in addition to the high percentage of infection with liver fluke found in this study (17). On the other hand, there are few references of economic losses by species, such as sheep (USD 1,946.67) and goats (USD 2,520.00) reported in Iran (4).

In conclusion, the Apurimac region is hyperendemic for fascioliasis in cattle and sheep; In addition, it generates monthly economic losses due to the seizure of viscera at the

Abancay slaughterhouse, one of the highest in the country, which threatens food security; Therefore, it is recommended to implement health programs for the control and prevention of this parasite with the breeders. On the other hand, although the percentage of infection by cystic echinococcosis was low, it is necessary to educate breeders on the importance of not feeding their dogs with raw viscera contaminated with cysts, to avoid the continuity of the biological cycle.

Conflict of interest

The authors declare that there are no conflicts of interests regarding the publication of this paper.

REFERENCIAS

1. Naquira C. Las zoonosis parasitarias: problema de salud pública en el Perú. *Rev Peru Med Exp Salud Publica*. 2010; 27(4):494-497. <https://doi.org/10.17843/rpmesp.2010.274.1518>
2. Valderrama AA. Prevalencia de fascioliasis en animales poligástricos de Perú. 1985-2015. *Rev Med Vet*. 2016; (32):121-129. <https://doi.org/10.19052/mv.3861>

3. Theodoropoulos G, Theodoropoulou E, Petrakos G, Kantzoura V, Kostopoulos J. Abattoir Condemnation due to Parasitic Infections and its Economic Implications in the Region of Trikala, Greece. *J Vet Med.* 2002; 49:281–284. <https://doi.org/10.1046/j.1439-0450.2002.00563.x>
4. Khoramian H, Arbabi M, Osqoi MM, Delavari M, Hooshyar H, Asgari M. Prevalence of ruminants fascioliasis and their economic effects in Kashan, center of Iran. *Asian Pac J Trop Biomed.* 2014; 4(11):918-922. <http://www.cnki.com.cn/Article/CJFDTotal-APT201411014.htm>
5. Shamsi L, Samaeinasab S, Samani ST. Prevalence of hydatid cyst, *Fasciola* spp. and *Dicrocoelium dendriticum* in cattle and sheep slaughtered in Sabzevar abattoir, Iran. *Ann Parasitol.* 2020; 66(2):211-216. <https://doi.org/10.17420/ap6602.256>
6. Getahun D, Henten SV, Abera A, Senkoro M, Owiti P, Lombamo F, Girma B, Ashenefe B, Deressa A, Diro E. Cysts and parasites in an abattoir in Northwest Ethiopia; an urgent call for action on “one health”. *J Infect Dev Ctries.* 2020; 14(6.1):53-57. <http://doi.org/10.3855/jidc.11713>
7. Nuñez M, Corrales M, Chirife C, Bejarano C, Presentado G. Prevalencia de *Fasciola hepatica* e hígados bovinos y pérdidas económicas por decomiso en un frigorífico del departamento central, República del Paraguay. *Compend Cienc Vet.* 2017; 7(2):17–21. <http://www.vet.una.py/dict/webccv13.html>
8. Giraldo JC, Díaz AM, Pulido MO, Prevalencia de *Fasciola hepatica* en Bovinos Sacrificados en la Planta de Beneficio del Municipio de Une, Cundinamarca, Colombia. *Rev Inv Vet Perú.* 2016; 27(4):751-757. <http://dx.doi.org/10.15381/rivep.v27i4.12572>
9. Pinilla JC, Uribe N, Florez AA, *Fasciola hepatica* y otras parasitosis gastrointestinales en bovinos de doble propósito del municipio Sabana de Torres, Santander, Colombia. *Rev Inv Vet Perú.* 2019; 30(3):1240-1248. <https://doi.org/10.15381/rivep.v30i3.16607>
10. Ramírez-Londoño F, Cárdenas-Pinto A, Arcila-Quiceno V, Cristancho R, Jaimes-Dueñez JE. Caracterización de decomisos de vísceras rojas en un frigorífico de exportación en Santander - Colombia. *Orinoquia.* 2020; 24(1):64-73. <http://doi.org/10.22579/20112629.592>
11. Palacio D, Bertot JA, Beltrao M, Vázquez A, Ortíz RC, Varona M. Pérdidas económicas inducidas por *Fasciola hepatica* en bovinos sacrificados en el matadero de Chacuba. en Camagüey. Cuba. *Cuban Journal of Agricultural Science.* 2019; 53(1):35-39. <http://www.cjascience.com/index.php/CJAS/article/view/852>
12. Hubener E, Dian PHM, Belo MAA, Soares VE. Cisticercose, facioloze e hidatididose em bovinos abatidos na área centro-oeste do estado de São Paulo. *Ars Veterinaria.* 2019; 35(3):93-99. <http://dx.doi.org/10.15361/2175-0106.2019v35n3p93-99>
13. Rojas D, Cartín JA. Prevalencia de *Fasciola hepatica* y pérdidas económicas asociadas al decomiso de hígados en tres mataderos de clase a de Costa Rica. *Agronomía Costarricense.* 2016; 40(2):53-62. <http://dx.doi.org/10.15517/rac.v40i2.27366>
14. Stoore C, Andrade C, Hidalgo C, Corrêa F, Jiménez M, Hernandez M, Paredes R. *Echinococcus granulosus* hydatid cyst location is modified by *Fasciola hepatica* infection in cattle. *Parasit Vectors.* 2018; 11:542. <https://doi.org/10.1186/s13071-018-3128-6>
15. Chávez A, Sánchez L, Arana C, Suárez F. Resistencia a antihelmínticos y prevalencia de fasciolosis bovina en la ganadería lechera de Jauja, Perú. *Rev Inv Vet Perú.* 2012; 23(1):90-97. <https://doi.org/10.15381/rivep.v23i1.887>
16. Julon D, Puicón V, Chávez A, Bardales W, Gonzales J, Vásquez H, et al. Prevalencia de *Fasciola hepatica* y parásitos gastrointestinales en bovinos de la Región Amazonas. Perú *Rev Inv Vet Perú.* 2020; 31(1):1-9. <http://dx.doi.org/10.15381/rivep.v31i1.17560>

17. Arias-Pacheco C, Lucas JR, Rodríguez A, et al. Economic impact of the liver condemnation of cattle infected with *Fasciola hepatica* in the Peruvian Andes. *Trop Anim Health Prod.* 2020; 52:1927–1932. <https://doi.org/10.1007/s11250-020-02211-y>
18. Sierra-Ramos R, Valderrama-Pomé A. Hiperendemia de equinococosis y fertilidad quística en porcinos del valle interandino de Huancarama. Perú. *Rev Peru Med Exp Salud Publica.* 2017; 34(2):250-254. <https://doi.org/10.17843/rpmesp.2017.342.2500>
19. Abdi J, Taherikalani M, Asadolahi K, Emaneini M. Echinococcosis/Hydatidosis in Ilam Province, Western Iran. *Iranian J Parasitol.* 2013; 8(3):417-422. <https://ijpa.tums.ac.ir/index.php/ijpa/issue/view/34>
20. Cruzat A, Silva A, Morales P, Carmona H. Caracterización de la prevalencia de hallazgos compatibles con hidatidosis y fertilidad de quistes hidatídicos en bovinos de una planta faenadora de la ciudad de Curicó, Chile. *Rev Inv Vet Perú.* 2019; 30(2):874-882. <https://doi.org/10.15381/rivep.v30i2.16087>
21. Valderrama AA, Huaranca E. Conocimientos y prácticas como factores de riesgo de hidatidosis en animales de Huancarama, Perú. *Revista del Colegio de Médicos Veterinarios del Estado Lara.* 2014; 1(7):7-12. <https://revistacmvl.jimdofree.com/suscripci%C3%B3n/volumen-7/hidatidosis/>
22. Servicio Nacional de Sanidad Agraria. Reglamento Sanitario del Faenado de Animales de Abasto. [en línea]. SENASA; 2012 [Consultado el 11 de enero 2020]. URL Disponible en: https://www.senasa.gob.pe/senasa/descargasarchivos/2014/11/DS_015_2012_AG-REGLAMENTO-SANITARIO-DEL-FAENADO-DE-ANIMALES-DE-ABASTO.pdf
23. Servicio Nacional de Meteorología e Hidrología del Perú, Apurímac. [en línea]. SENAMHI; 2016. <https://senamhi.gob.pe/main.php?dp=apurimac>
24. Blancas G, Terashima A, Maguiña C, Vera L, Álvarez H, Tello R. Fasciolosis humana y compromiso gastrointestinal: Estudio de 277 pacientes en el Hospital Nacional Cayetano Heredia. 1970–2002. *Rev. Gastroenterol.* 2004; 24:143-157. <http://www.revistagastroperu.com/index.php/rgp/article/view/684>
25. Arjona R, Riancho JA, Aguado JM, Salesa R, González-Macías J. Fascioliasis in developed countries: a review of classic and aberrant forms of the disease. *Medicine.* 1995; 74(1):13-23. <https://doi.org/10.1097/00005792-199501000-00002>
26. Carrada-Bravo T, Escamilla JR. Fasciolosis: revisión clínico-epidemiológica actualizada. *Rev Mex Patol Clin.* 2005; 52(2):83-96. <https://www.medigraphic.com/cgi-bin/new/contenido.cgi?IDPUBLICACION=339>
27. Carrada-Bravo T. Fascioliasis. Diagnóstico, epidemiología y tratamiento. *Rev Gastroenterol Mex.* 2003; 68:135-42. <http://www.revistagastroenterologiamexico.org/es-vol-68-num-2-sumario-X0375090603X66495>
28. Abebe A, Beyene D, Kumsa B. Cystic echinococcosis in cattle slaughtered at Gondar Elfora export Abattoir, northwest Ethiopia. *J Parasit Dis.* 2014; 38(4):404–409. <https://doi.org/10.1007/s12639-013-0255-z>
29. Rau E, Rivero M, Tisnés A, Fernández R. Epidemiología de hidatidosis en bovinos de consumo en la comarca andina del paralelo. *Rev Argent Salud Pública.* 2019; 10(41):22-27. <http://rasp.msal.gov.ar/indice-msal.asp?id=70>
30. Armiñanzas C, Gutiérrez-Cuadra M, Fariñas MC. Hidatidosis: aspectos epidemiológicos, clínicos, diagnósticos y terapéuticos. *Rev Esp Quimioter.* 2015; 28(3):116-124. <https://seq.es/revista-de-la-seq/2015-revista-de-la-seq/junio-2015-vol-283-116-168/>
31. Al-Kitani F, Baqir S, Hussain MH, Roberts D. Cystic hydatidosis in slaughtered goats from various municipal abattoirs in Oman. *Trop Anim Health Prod.* 2014; 46:1357–1362. <https://doi.org/10.1007/s11250-014-0646-x>

32. Tezer H, Yuksek SK, Parlakay AÖ, Gülhan B, Tavil B, Tunç B. Evaluation of cases with *Fasciola hepatica* infection: experience in 6 children. *Asian Pacific Journal of Tropical Disease*. 2013; 3(3):211–216. [https://doi.org/10.1016/S2222-1808\(13\)60043-2](https://doi.org/10.1016/S2222-1808(13)60043-2)
33. Alpizar CE, Bianque J, Jiménez AE, Hernández J, Berrocal A, Romero JJ. *Fasciola hepatica* en ganado bovino de carne en Siquirres y lesiones anatomo-histopatológicas de hígados bovinos decomisados en mataderos de Costa Rica. *Agron Costarricense*. 2013; 37(2):7-16. http://www.mag.go.cr/rev_agr/v37n02_indice.html
34. Delgado A, García C, Allcahuamán D, Aguilar C, Estrada P, Vega H. Caracterización fenotípica del ganado criollo en el Parque Nacional Huascarán – Ancash, Perú. *Rev Inv Vet Perú*. 2019; 30(3):1143-1149. <http://dx.doi.org/10.15381/rivep.v30i3.16611>