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Prevalence, Risk Factors and Economic Impacts of Ruminant Echinococcosis in the Urban Slaughterhouse of Dedougou, Burkina Faso

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A B S T R A C T

Parasitic diseases in domestic animals are a permanent obstacle for production, food safety and consumer health. The present work was conducted from september 2020 to april 2021 at the Dedougou abattoir to evaluate the prevalence of echinococcosis and the risk factors associated to this pathology in ruminants. Out of 14497 ruminants inspected, the prevalence of echinococcosis was 0.21%. The prevalence of echinococcosis in cattle, goats and sheep was 0.1%, 0.2% and 0.5% respectively, suggesting a significant effect of species on the transmission of the disease (*P*-value = 0.0203). Sheep were the most susceptible followed by goats. In addition to the animal species, the effect of animal's age on the level of infestation was also significant, particularly for goats where the prevalence in animals under two years old (0.4%) was relatively higher (*P-value*=0.0001) than that recorded in animals over two years old (0.06%). Regarding the other risk factors studied, no significant impact was observed. Regarding condemnation, intestines (70.96%), livers (9.67%), and spleens (19.35%) were the organs affected by hydatid cysts and therefore seized. In view of the importance of ours results, control strategies must be put in place against this pathology in the commune in order to further reduce its impact on ruminants and to serve consumers with safe meat.

Introduction

Echinococcosis is a zoonosis that continues to be a major public health problem in near all regions of the world (Salem & Maher, 2018; Wen *et al.,* 2019). This pathology is an infestation due to *Taeniidae* parasites of the genus *Echinococcus* that results in considerable morbidity and mortality in affected areas (Craig *et al.,* 2007).

Almost mammals, including humans, are intermediate hosts of these parasites, for which carnivores (dogs and foxes) are the definitive hosts.

Several studies have shown that this disease is a growing public health problem and can be considered an emergent or re-emergent disease (Eckert *et al.,* 2000; Jenkins *et al.,* 2005).

Six species of Echinococcus have been identified (Moro & Schantz, 2008) but *Echinococcus granulosus*, found throughout the world, and *E. multilocularis*, widespread in the northern hemisphere, are the two species that carry the greatest zoonotic risk. Depending to the species, the echinococci can develop as cysts (cystic echinococcosis, hydatid disease), small vesicles (alveolar echinococcosis), or intermediate vesicles (polycystic echinococcosis).

In sub-Saharan Africa, only cystic echinococcosis (CE) is present (Romig *et al.,* 2011). This form of the disease is spread in almost all countries in this part of the African continent. The pathology is, unfortunately, poorly documented in most West African countries (Romig *et al.,* 2011). In Burkina Faso, the epidemiological situation of this disease is particularly little known in most parts of the country's thirteen (13) regions and consequently requires investigations to determine the current situation.

Therefore, the present work was undertaken in order to evaluate the prevalence of echinococcosis and the risk factors associated to this pathology in ruminants at the Dedougou abattoir in the Boucle of Mouhoun Region.

Materials and Methods

Study area

The current study was conducted at the communal refrigerated slaughterhouse of Dedougou. This slaughterhouse is located to the east of the Dedougou city at about five kilometers from the city center on the axis Dedougou-Ouagadougou.

The urban commune of Dedougou is located in the Boucle of Mouhoun region, precisely in the province of Mouhoun and Dedougou city is both the provincial and regional capital.

The commune of Dedougou is one of the seven (07) communes and the single urban commune of the Mouhoun province (Figure 1). Dedougou city is at 230 km from the political capital, Ouagadougou, and 175 km from Bobo Dioulasso, the economical capital.

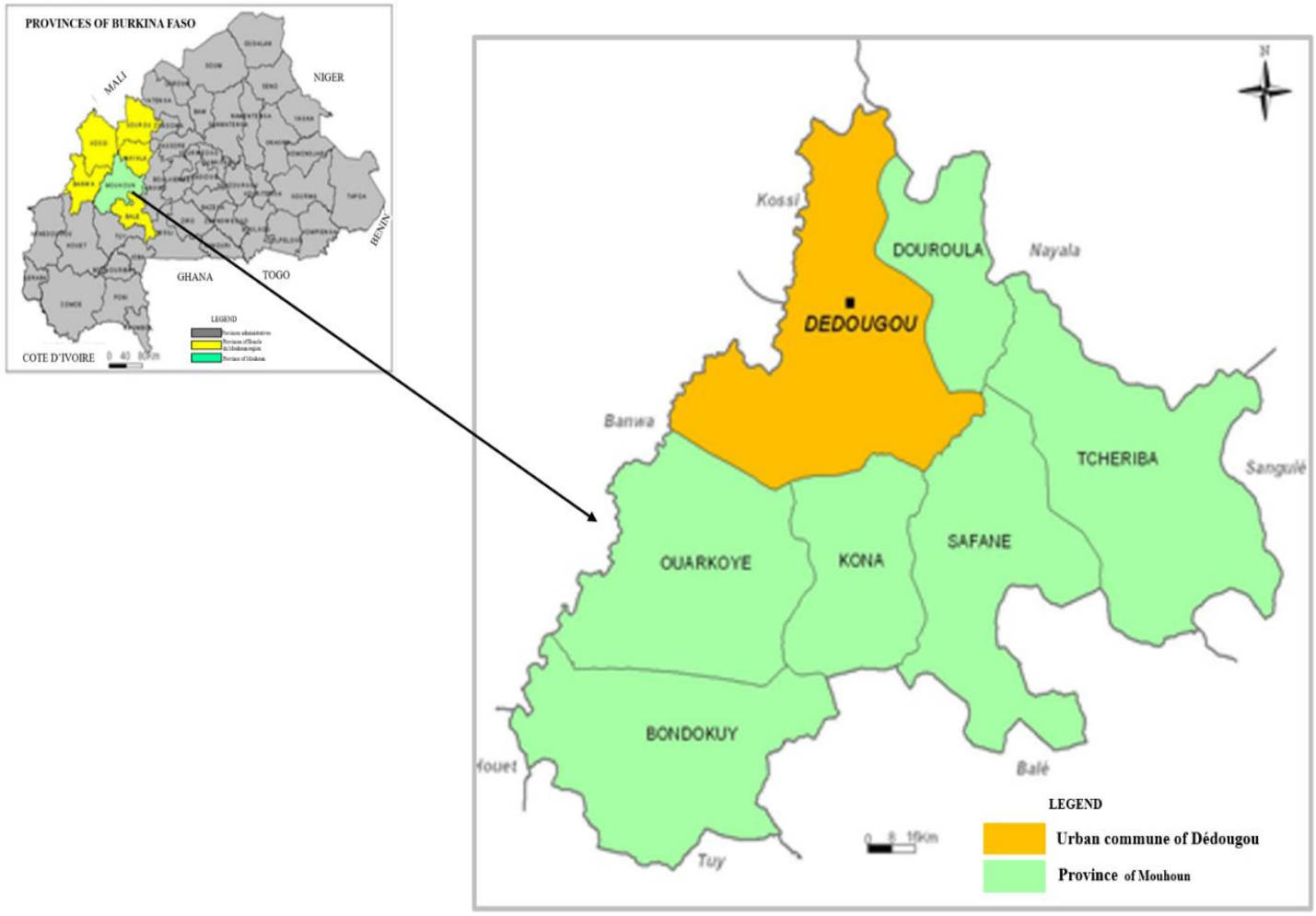
Animal samples

The biological material used in this study was 14497 ruminants including 2176 cattle, 11062 goats and 1259 sheep slaughtered at the slaughterhouse of Dedougou from september 2020 to april 2021.

Inspection methods

Before slaughtering, information on the species, breed, age and sex of each animal as well as the date of slaughter was collected. Each of these animals was subjected to a post-mortem inspection after slaughter to establish the diagnosis of echinococcosis. For this purpose, we proceeded by palpation, incision and observation to examine the carcasses and organs such as the spleen, lungs, liver, heart, digestive viscera (stomach and intestines), head and tongue. At the end of the inspections, all organs with hydatid cysts were condemned and incinerated. For the animals diagnosed as diseased, information on the price of the condemned organs was taken from the butchers to determine the losses due to these condemnation.

Fig.1 Geographical location of the urban commune of Dedougou



Data processing and analysis

The collected data were entered and saved on the Excel 2013 worksheet, which was also used to make the figures. These data were used to perform descriptive (frequency and percentage) and statistical analyses of echinococcosis prevalence rates as well as risk factors. For this purpose, the Chi-square test at the 5% level or Fisher's test, where appropriate, was used to compare the parameters measured using R software. Prevalences were calculated as a percentage (Thrusfield, 2007) using the following equation:

$$\text{Prevalence} = \frac{\text{Number of infected animals}}{\text{Number of inspected animals}} \times 100$$

Results and Discussion

Overall prevalence

The overall prevalence of ruminant echinococcosis in the present study was 0.21% corresponding to 31 positive cases out of a total of 14497 ruminants inspected. All echinococcosis cysts were found in the viscera including liver, spleen and intestines.

Risk factors

Ruminant species

Table 1 show the prevalence of echinococcosis according to ruminant species. Sheep were significantly more exposed to infestation than goats and cattle (*P*-value<0.05).

Ruminant breed

During the study, two breeds of cattle (Zebu and Taurine), goats (Djallonke and Mossi) and sheep (also Djallonke and Mossi) were identified. For cattle, only zebus were infested. For small ruminants, the prevalences of infestation observed in Djallonké breeds were slightly higher than those of Mossi breeds. However, the differences observed were not significant at the 5% level, since the smallest *P*-value from comparisons between breeds of the three ruminant species was 0.06 (Table 2).

Ruminants' age

Cattle older than two years old, 3 cases out of 2029 animals inspected, i.e. 0.15%, were more infested than cattle of at least 2 years old (0 cases out of 147) (Figure 2). In contrast to cattle, small ruminants under two years old were more infested than animals of at least two years old, but the differences observed were only statistically significant for the goat species (*P*-value<0.05).

Sex of the animals

Overall, 8520 females and 6477 males were inspected and the number of infested cases was 19 for females and 12 for males, i.e. prevalences of 0.22% and 0.19% respectively. The detailed results of sex effect on the infestation level for the three ruminant species are shown in Table 3. The smallest *P-value* of the comparison between males and females infestation levels was observed with cattle (*P*-value=0.28), suggesting a no significant effect of animals' sex on their infestation risk.

Season

Infestations occurred throughout the study's duration in small ruminants, in contrast to cattle for which no infestation was occurred during the hot dry season (march-april). A slight increase of prevalence was also observed in the cold dry season for cattle (0.23) and goats (0.28), while sheep had the highest prevalence in the rainy season (0.74). However, the observed differences were not significant, suggesting that the season does not have a significant influence on the prevalence of echinococcosis (*P*-values>0.05).

Meat condemnation and economic impacts

The condemnations performed during the post-mortem examination are recorded in Table 4. All the operated condemnations were partial and condemned organs were mostly the intestines

(70.96%) followed by spleen (19.35%) and the liver (9.67%). Based on the average price of the condemned organs according to the butchers, the condemnations caused an overall economic loss of approximately XOF 30,900. The cost of the small ruminant spleen could not be estimated because most of the butchers do not sell this organ in detail. Therefore, the present loss assessment does not take into account this organ for small ruminants.

The prevalence of echinococcosis in slaughtered ruminants at the Dedougou communal abattoir during the present study was 0.28%. This prevalence is significantly lower than those reported in some North African countries, such as Moroc, where a prevalence of over 11% was reported by Guillermo *et al.,* (2013). The low prevalence values observed in the present study can be explained by environmental and climatic factors of the study setting. Indeed, according to Laws (1968), the eggs of *E. granulosus* would resist only during 24 hours to the temperature of 35° or more. However, in the Boucle of Mouhoun region, average temperatures are quite high throughout the year. They can vary from 28°C in the rainy season to 40°C in the dry season (RGPH, 2009). These conditions are particularly unfavorable for the resistance of the parasite's eggs in the environment and for their transmission.

The prevalence by animal species were 0.1% for cattle, 0.2% for goats and 0.5% for sheep suggesting a significant species effect on the transmission of the disease. These prevalence were similar to those reported by Guillermo *et al.,* (2013) in Mauritania for cattle and goats (0.1% and 0.2%), but higher than the prevalence reported for sheep by these authors (0.2%). However, the estimated prevalence in our study were lower than those observed in Sudan by Omer *et al.,* (2010) which were 6.1%, 1.9% and 11.3% respectively for cattle, caparins and sheep. On the other hand, local breeds, taurines for cattle and mossi breeds for small ruminants, have been shown to be less susceptible, although not significantly, to the disease's transmission. To date, as far as we know, no study has explored the effect of breed on echinococcosis infestation in ruminants. However, local breeds are generally known to be very hardy and natural resistance to trypanosomes has been reported in taurines (Hanotte *et al.,* 2003; Naessens *et al.,* 2003 and O'Gorman *et al.,* 2006). These qualities could also explain their level of susceptibility in the present study.

Cattle under two years old were relatively less infested than adults. This finding corroborates well with the results of Cabrera *et al.,* (2002); Dueger and Gilman (2001) and Lahmar *et al.,* (1998) who estimated that the frequency of hydatid cysts increases with animals' age. In fact, young cattle at 2 years old are just beginning to visit infested pastures and do not make long journeys. This explains their low infestation rate compared to older animals (over 2 years old) in our study. This is not the case for small ruminants where young animals fully frequent pastures from their first year of birth in Burkina Faso.

Our results further revealed that infestations occurred during all seasons (dry and rainy). These results confirm the work of Almalki *et al.,* (2017) who showed that hydatid cyst infestations exist year-round in Saudi Arabia. According to Thompson *et al.,* (1995), the egg of *E. granulosus* has a high survival capacity especially at low temperatures. This would justify the frequency of *E. granulosus* eggs throughout the study period from september to april. However, the effect of temperature on parasite egg survival could further explain the relatively high prevalence during the cold season for cattle and goats, and during the wintering period for sheep. Indeed, during these periods of the year, the temperature is low enough to favor the survival of *E. granulosus* eggs in the environment. Concerning the organs condemnation, the economic losses induced for the three ruminant species were XOF 30900, so a significant sum for the butchers. These condemnations could be explained by the lack of care for the ruminants raised by the farmers who supply the abattoir of Dedougou.

Table.1 Prevalence of echinococcosis according to ruminant species

Species	Numbers		Prevalence (%)	*P*-value
	Inspected	Infested		
Cattle	2176	3	0 .1	**0.0203**
Goat	11062	21	0.2	
Sheep	1259	7	0.5	

Table.2 Prevalence of echinococcosis according to ruminant breeds

Species	Races	Numbers		Prevalence (%)	*P*-value
		Inspected	Infested		
Cattle	Zebu	2160	3	0.13	1
	Taurine	13	0	0	
Goat	Mossi	11007	20	0.18	0.06
	Djallonké	34	1	2.9	
Sheep	Mossi	1239	6	0.48	0.07
	Djallonké	13	1	7.9	

Table.3 Level of animals infestation according to the sex

Species	Sex	Numbers		Prevalences (%)	*P*-value
		Inspected	Infested		
Cattle	Male	764	2	0.26	0.28
	Female	1412	1	0.07	
Goat	Male	5551	9	0.16	0.6
	Female	6011	12	0.20	
Sheep	Male	162	1	0.62	1
	Female	1097	6	0.55	

Table.4 Effected condemnation and associated financial losses

Species	Condemned Organs	Number	Unit price (XOF)	Economic loss (XOF)
Cattle	Liver	2	3700	7400
	spleen	1	1000	1000
Goat	Liver	1	500	500
	spleen	4	-	-
	intestines	16	1000	1600
Sheep	spleen	1	-	-
	intestines	6	1000	6000
Overall	-	-	-	30 900

Fig.2 Prevalence of echinococcosis according to animals' age group

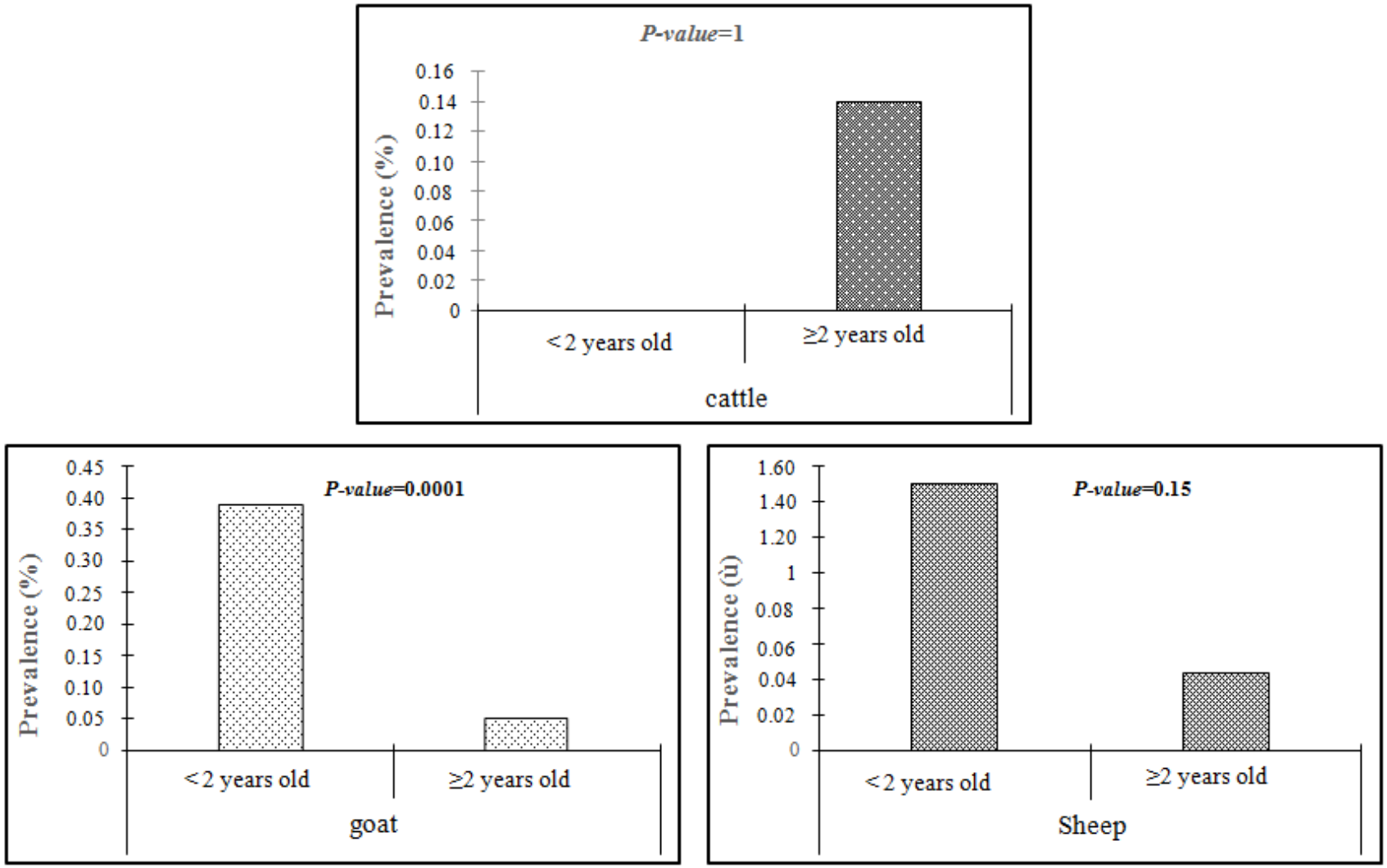
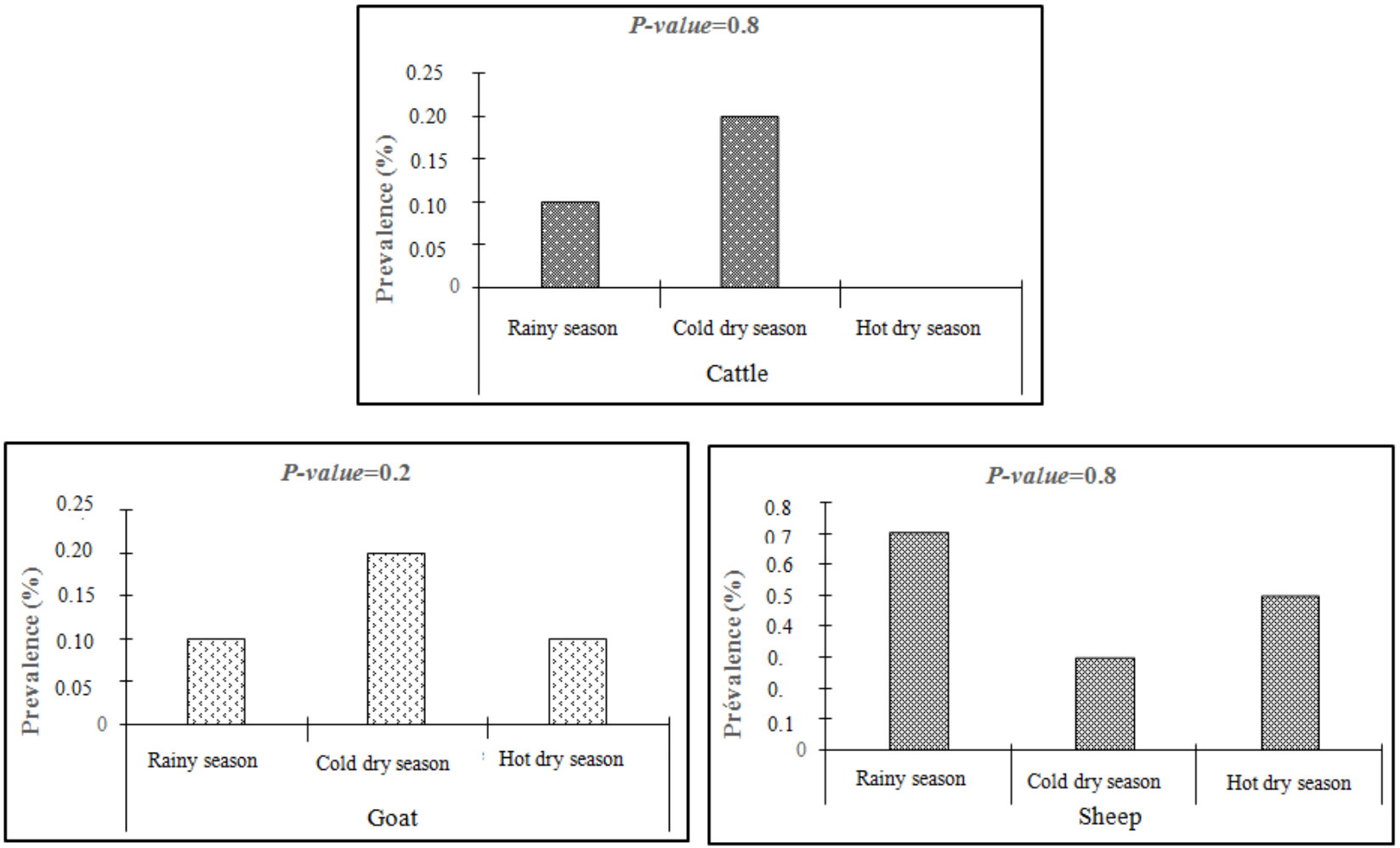


Fig.3 Seasonal prevalence of echinococcosis for the three ruminant species slaughtered at the Dedougou slaughterhouse



In addition to the observed economic losses, the presence of this pathology in the animals slaughtered at the abattoir, shows the sanitary stakes for the consumers in the commune.

It is therefore imperative that measures be taken to break the chain of transmission of this pathology in view of its zoonotic nature and to ensure the production of healthy meat for the population.

The present study on ruminant echinococcosis showed that this disease is present in animals during all seasons. The results of the study also showed that the large majority of the studied factors did not have a significant influence on the prevalence of echinococcosis in slaughtered ruminants, except for the effects of species and age, especially in goats, where the infestation due to *E. granulosus* was significantly remarkable. Ruminant echinococcosis caused significant economic losses to butchers through the organs condemnation. Strategies for good management of ruminants in the region should be developed to reduce the prevalence of this disease, given its zoonotic aspect. Human diagnostic tests are also needed to establish the risk incurred by consumers given the clandestine slaughters and free roaming of stray dogs that occur in the province, especially in rural areas.

Conflict of interest

The authors declare that there is no conflict of interest

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