EPIDEMIOLOGICAL STUDIES ON *FASCIOLA HEPATICA* IN GAFSA OASES (SOUTH WEST OF TUNISIA)

HAMMAMI H.*, HAMED N.* & AYADI A.*

Summary:

Epidemiological investigations on *Fasciola hepatica* fasciolasis were carried out from July 2004 to June 2005 in the Gafsa oases (Tunisia) after the detection of a human case. Three habitats were studied: one in El Gsar and two in Ain Soltan. The prevalence of human infection was 6.6 %. The presence of the parasite was detected through serology in 14.3 % of cattle, 35 % of sheep and 68.4 % of goats. The plants *Apium nodiflorum, Oxalis cernua* and *Sonchus maritimus* were suspected to be at the origin of animal contamination and *Apium nodiflorum* was incriminated in human infection. The prevalence of the infection of the intermediate host *Galba truncatula* (*G. truncatula*) was 19.2 % from July 2004 to June 2005. Gafsa oases constitute a new location for the development of fasciolasis in the southern west of Tunisia.

KEY WORDS : epidemiology, *Fasciola hepatica, Galba truncatula,* Tunisia.

Résumé : ÉTUDE ÉPIDÉMIOLOGIQUE SUR LA DISTOMATOSE À *FASCIOLA HEPATICA* DANS LES OASIS DE GAFSA, AU SUD-OUEST DE LA TUNISIE

Une enquête épidémiologique sur la distomatose à Fasciola hepatica *a été réalisée de juillet 2004 à juin 2005 dans les oasis de Gafsa (Tunisie) à la suite de la découverte d'un cas humain. Trois habitats ont été prospectés : un à El Gsar et deux à Ain Soltan. La prévalence de l'infestation humaine était de 6,6 %. Le dépistage sérologique a montré la présence du parasite chez 14,3 % des bovins, 35 % des ovins et 68,4 % des caprins. Les plantes* Apium nodiflorum, Oxalis cernua *et* Sonchus maritimus *ont été les plus suspectées d'être à l'origine de la contamination du bétail.* Apium nodiflorum *a été incriminée comme plante responsable de l'infestation humaine. La prévalence de l'infestation de l'hôte intermédiaire* Galba truncatula *était de 19,2 % entre juillet 2004 et juin 2005. Les oasis de Gafsa constituent un nouveau foyer du sud ouest tunisien favorable au développement de la distomatose.*

MOTS CLÉS : *épidémiologie,* Fasciola hepatica, Galba truncatula, *Tunisie.*

The fasciolosis caused by *F. hepatica* Linnaeus, 1758, a parasite trematode, is of considerable medical and veterinarian importance, because it contaminates the breeding of cattle, goats, horses, ovines and swines, resulting in serious losses for the cattle and as a matter of fact raising economic problems in many countries. This old disease has a great power of expansion in view of the large colonisation capacities of its fasciolid causal agents as well as the freshwater lymnaeid snail vector species (Mas-Coma *et al.*, 2001). Recent reports indicate that fasciolasis is a re-emerging highly pathogenic human infection whose epidemiological picture has changed in recent years (Moghaddam *et al.*, 2004). About 17 million people, most of them are children, are thought to be infected by the liver fluke *F. hepatica*, including human endemics in Europe, Asia, Africa and America (Hopkins, 1992). In Tunisia, 36 cases of human fasciolasis have been reported since the first human case recorded in 1940. Most of patients are natives of the north or the south-west Tunisian oases. What is worth noting is that children are the most frequently affected social slice (Ayadi *et al.*, 1997). There are two ecological sites which are particularly favourable to fasciolasis development in Tunisia. The first in the north with classic ecological conditions (Jemli *et al.*, 1991) and the second in the south-west with a microclimate suitable to the development of the parasitosis (Ayadi *et al.*, 1993; Hammami & Ayadi, 1999). Recently a human case of distomatosis has been reported in Gafsa oases (Sellami *et al.*, 2003).

The aim of the present paper was to determine the epidemiology of fasciolasis in Gafsa oases. The focal points were upon the frequency of this disease in humans and animals, the prevalence of the natural infection of the intermediate host *G. truncatula* and the identification of the plants causing contamination of the definitive host.

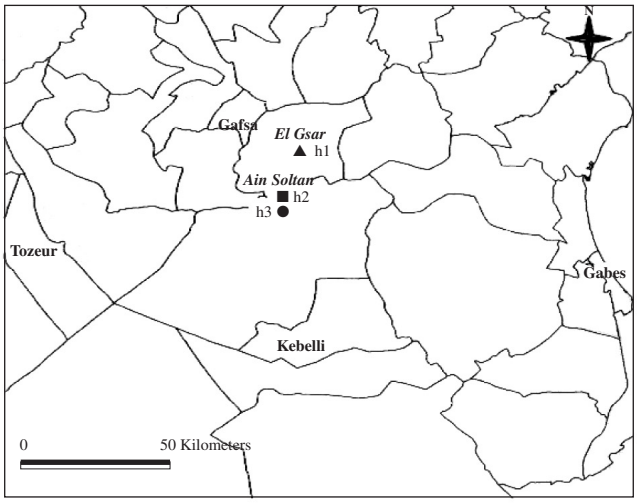
MATERIALS AND METHODS

STUDIED STATIONS

Gafsa is located in the south-west of Tunisia, bordered on the north by Kasserine, on the south by Kebelli, on the south east by Gabes

* Parasitology-Mycology Laboratory, School of Medicine, Sfax, Tunisia.
Correspondance: Pr Ayadi Ali, Parasitology-Mycology Laboratory, Habib Bourguiba Hospital, Sfax, Tunisia.
Tel. / Fax: 00216 74 247130 – E-mail: ali.ayadi@rns.tn

Geographical location of Gafsa delegation



Legend: habitats: h1 (▲) in El Gsar; h2 (■) and h3 (●) in Ain Soltan

Fig 1. – Location of *Galba truncatula* habitats in Gafsa oases.

and on the west by Tozeur (Fig. 1). It is characterised by an arid climate with a very warm summer and a mild winter. The range of mean monthly pluviometry was 10.9 mm and that of mean monthly temperature was 19.4° C from July 2004 to May 2005. Prospected *G. truncatula* habitats are located in El Gsar oases (one habitat: h1) and Ain Soltan oases (two habitats: h2 and h3) (Fig. 1). The h1 belongs to a cemented "*seguia*" (traditional canal) supplied with water from drilling and surface well. The *seguia* has an area of 8.4 m^2 and a depth of 25 cm. The substratum is made up of silt and sand covered partly by algae. Plants line the *seguia*. Water covers 4 cm of the habitat depth. The h2 13.8 m^2 in area belongs to a barrage located on the watercourse of oued El Melah. The water covers 60 cm of the habitat. The third habitat is a *seguia* of 27.5 m^2 that derives from the barrage on the watercourse of oued El Melah.

Experimental protocols

. Human and animal fasciolosis: our investigations about the importance of animal and human fasciolasis in Gafsa oases are based on serological analysis using hemagglutination and electrosyneresis techniques. A total of 30 sera belonging to asymptomatic humans were randomly chosen among people living in El Gsar oases: eight human with an age ranging from 15 to 30, eight others with an age ranging from 31 to 50 and 14 with an age from 51 to 82 years.

. Sera from 53 animals: 14 cattle (all raised in El Gsar oases), 20 sheep (nine from El Gsar and 11 from Ain Soltan oases) and 19 goats (all from Ain Soltan oases) were examined to check the presence of fluke infection by taking blood samples. These animals are grazing herbs from these habitats and are living in El Gsar and Ain Soltan oases.

. Plant collection: the three habitats were investigated every month during the study period from July 2004 to May 2005. Plants were collected from the three waterholes in which they grow spontaneously and then they were identified.

. Snail infection: monthly investigations on *G. truncatula* have been carried out from July 2004 to May 2005. Snails were collected from h1, h2 and h3 and transported to the laboratory in isothermal conditions. A number of 1,346 snails, whose heights ranging from 3.5 to 5.5 mm, have been dissected and observed by means of a microscope so as to identify *F. hepatica* larval stages and to determine the infection rate.

RESULTS

The diagnostic of human fasciolasis by serology was positive for two human cases among 30 (6.6 %): one case with an age of 19 years ranging from 15 to 30 and another with an age of 41 years ranging from 31 to 50. The serology was negative for the slice age from 51 to 82 years.

The infection rate was 41.5 % for animals. Two cattle among 14 (14.3 %), seven sheep (one from El Gsar and six from Ain Soltan) among the 20 (35 %) and 13 goat among the 19 (68.4 %) were infected.

Three major plants have been collected in El Gsar and Ain Soltan habitats: *Apium nodiflorum* was frequent in the bank and the bottom of the three habitats from November to August. *Oxalis cernua* grew in the *seguia*: h1 and was frequent in all cultivated parcels on February, March and April. *Sonchus maritimus* have grown from February to August on h1 and h3. Examination of leaves and stems of these plants did not show metacercaria. Human infected cases have mentioned that *Apium nodiflorum* was responsible for their contamination.

Infected snails have been found during all months except July and August. The prevalence of the natural

Habitats	Number of snails collected and prevalence of snail infection in %			
	h1	h2	h3	Total
Months of study				
July	17 (0)	0 (0)	0 (0)	17 (0)
August	11 (0)	0 (0)	0 (0)	11 (0)
September	54 (20.4)	20 (0)	20 (0)	94 (11.7)
October	35 (25)	32 (34)	30 (43)	97 (35)
November	53 (1.8)	39 (28)	46 (67)	138 (31.1)
December	46 (19)	51 (64.7)	44 (45)	141 (43.9)
January	26 (30)	32 (6.2)	29 (48)	87 (27.5)
February	47 (46)	22 (18)	34 (2.9)	103 (26.2)
March	70 (7)	25 (4)	25 (0)	89 (26.9)
April	70 (5)	35 (0)	33 (18)	138 (7.9)
May	39 (2.6)	37 (8.1)	32 (18.7)	108 (9.2)
June	35 (2.8)	50 (14)	38 (13.1)	123 (10.6)
Total	472 (19.3)	543 (13.2)	331 (29)	1,346 (19.2)

Table I. – Monthly prevalence of natural infection with *F. hepatica* in three populations of *G. truncatula* from the districts of El Gsar and Ain Soltan oases for the year 2004/2005.

infection was 19.2 % for all molluscs collected (Table I). Two infection periods have been observed in each habitat: from September to October and December to April in h1; from October to March and May to June in h2, and from October to January and April to June in h3.

DISCUSSION

In Tunisia human fasciolasis is not common whereas animal infection is more frequent in the north and the southern west of Tunisia. In our study, the lower rate of 6.6 % in human cases goes in tandem with the rate reported by many authors in the world: 2 % to 17 % in Egypte (Lotfy & Hillyer, 2003); 1.8 % in Turkey (Yilmaz & Gödekmerdan, 2004). However human rate of fasciolasis was higher in Mantaro-Valley: 36.3 % in Huertas and 22.7 % in Julcan (Raymundo *et al.*, 2004). This was explained by the specificity of alimentary habits based on consumption of salads in the corresponding regions.

Serological investigations of 53 sera from Gafsa region revealed a rate of 35 % in sheep and 68.4 % in goat higher than in cattle (14.3 %). This could be explained by the fact that cattle were kept in farms and sheep and goats were grazing herbs from habitat with infected snails. This is in accordance with the results found in Tozeur oases (Ayadi *et al.*, 1997). The infection rate of ovine was lower in Algeria (6.4 % in Constantine and 23 % in Jijel) (Mekroud *et al.*, 2004); 7.3 % in Iran (Moghaddam *et al.*, 2004). But the rate was more important in cows in Bolivia (100 %) (Mas-Coma *et al.*, 1999) and in Ethiopia (51.2 %) (Yilma & Mesfin, 2000). Usually sheep and cattle are preferential hosts; goats are a less receiver and less parasitized. But in our study goats have a high rate of infection in El Gsar oases. The high number among this species in the southern west of Tunisia oases suggests that they play a local role in the transmission of the parasite.

Oxalis cernua and *Apium nodiflorum* were appreciated for their acidic taste by few oases inhabitants. *Apium nodiflorum* was described as a plant that contaminated natural watercress beds from the Limousin region in Central France (Dreyfuss *et al.*, 2005). *Oxalis cernua, Apium nodiflorum* and *Sonchus maritimus* were suspected to be at the origin of animal contamination.

The prevalence of natural infection of *G. truncatula* with *F. hepatica*: 19.2 % in Gafsa's oases was important and similar to that reported in Tozeur oases: 26 % (Hammami & Ayadi, 2000). Whereas in Limousin region, the rate was 5.1 % (Mage *et al.*, 2002). In our study, two infestation periods were described in each habitat. This result is similar to that found in the middle of France with two infection periods: from June to July and from September to October. However, in the middle of Mexico, the infection of *G. truncatula* occurred only in August and November (Mendoza *et al.*, 2005); in Florida from February to April (Kaplan *et al.*, 1997) and in the north-east of Algeria from January to April in Constantine and from December to May in Jijel (Mekroud *et al.*, 2004).

REFERENCES

AYADI A., BEN RACHID M.S., KANNOU H., BRADAI K. & RONDELAUD D. Étude épidémiologique sur un foyer de distomatose à *F. hepatica* L. dans les oasis de Tozeur (Tunisie). *Bulletin de la Société Française de Parasitologie*, 1993, *11*, 217-222.

AYADI A., MAKNI F. & BEN SAID M. État actuel de la fasciolose en Tunisie. *Bulletin de la Société Française de Parasitologie*, 1997, *15*, 27-32.

DREYFUSS G., VIGNOLES P. & RONDELAUD D. *Fasciola hepatica*: epidemiological surveillance of natural watercress beds in central France. *Parasitology research*, 2005, *95*, 278-282.

HAMMAMI H. & AYADI A. Écologie de *Lymnaea truncatula* Müller, hôte intermédiaire de *Fasciola hepatica* Linné dans le microclimat de Tozeur (sud-ouest de la Tunisie). *Bulletin de la Société de Pathologie Exotique*, 1999, *92*, 302-304.

HAMMAMI H. & AYADI A. Étude de l'infestation naturelle de *Lymnaea truncatula* Müller par *Fasciola hepatica* dans les oasis de Tozeur (sud-ouest Tunisien). *Médecine Tropicale*, 2000, *60*, 159-162.

HOPKINS D.R. Homing in on helminths. *American Journal of Tropical Medicine and Hygiene*, 1992, *46*, 626-634.

JEMLI M.H., RHIMI I., JDIDI A., MASTOURI L. & KILANI M. La fasciolose ovine dans la région de Sejnane (nord de la Tunisie). *Revue de Médecine Vétérinaire*, 1991, *142*, 229-235.

KAPLAN R.M., DAME J.B., REDDY G.R. & COURTNEY C.H. The prevalence of *Fasciola hepatica* in its snail intermediate host determined by DNA Probe Assay. *International Journal for Parasitology*. 1997, *27*, 1585-1593.

LOTFY W.M. & HILLYER G.V. *Fasciola* Species in Egypte. *Experimental Pathology and parasitology*, 2003, *6*, 9-17.

MAGE C., BOURGNE H., TOULLIEU J.M., RONDELAUD D. & DREYFUSS G. *Fasciola hepatica* and *Paramphistomum daubneyi*: changes in prevalences of natural infections in cattle and in *Lymnaea truncatula* from central France over the past 12 years. *Veterinary Research*, 2002, *33*, 439-447.

MAS-COMA S., ANGLES R., ESTEBAN J.G., BARGUES M.D., BUCHON P., FRANKEN M. & STRAUSS M. The northern Bolivian Altiplano: a region highly endemic for human fasciolasis, *Tropical Medicine and International Health*, 1999, *4*, 454-467.

MAS-COMA S., FUNATSU I.R. & BARGUES M.D. *Fasciola hepatica* and lymnaeid snails occurring at very high altitude in South America. *Parasitology*, 2001, *123*, 115-127.

MEKROUD A., BENAKHLA A., VIGNOLES P., RONDELAUD D. & DREYFUSS G. Preliminary studies on the prevalences of natural fasciolosis in cattle, sheep and the host snail (*Galba truncatula*) in north-eastern Algeria. *Parasitology Research*, 2004, *92*, 502-505

MENDOZA I., IBARRA-VELARDE F., QUITERO-MARTINEZ M.T., NARANJO-GARACIA E., LECUMBERRI-LOPEZ J. & CORREA D. Seasonal transmissiom of *Fasciola hepatica* in cattle and *Lymnaea* (*Fossaria*) humilis snails in Central Mexico. *Parasitology Research*, 2005, *95*, 283-286.

MOGHADDAM A.S., MASSOUD J., MAHMOODI M., MAHVI A.H., PERIAGO M.V., ARTIGAS P., FUENTES M.V., BARGUES M.D. & MAS-COMA S. Human and animal fasciolasis in Mazandaran province, northern Iran. *Parasitology Research*, 2004, *94*, 61-69.

RAYMUNDO LA., FLORES V.M., TERASHIMA A., SAMALVIDES F., MIRANDA E., TANTALEAN M., ESPINOZA J.R. & GOTUZZO E. Hyperendemicity of human fasciolasis in the Mantaro Valley, Peru: factors for infection with *Fasciola hepatica*. *Revista de Gastroenterologìa del Perù*, 2004, *24*, 158-164.

SELLAMI H., ELLOUMI M., CHEIKHROUHOU F., MAKNI F., BAKLOUTI S. & AYADI A. *Fasciola hepatica* infestation with joint symptoms. *Joint Bone Spine*, 2003, *70*, 71-72.

YILMA J. M. & MESFIN A. Dry season bovine fasciolasis in northwestern part of Ethiopia. *Revue de Médecine Vetérinaire (Toulouse)*, 2000, *151*, 493-500.

YILMAZ H. & GÖDEKMERDAN A. Human fasciolasis in Van province, Turkey. *Acta Tropica*, 2004, *92*,161-162.

Reçu le 10 octobre 2006
Accepté le 3 mai 2007