Biochemical profiles of hydatid cyst fluids of *Echinococcus granulosus* of human and animal origin in Libya

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Abstract

A comparative study on the biochemical parameters in hydatid cyst fluids of sheep, goats, camels, cattle and human cystic forms of *Echinococcus granulosus* has been made in Libya. Quantitative variations in the levels of sodium, potassium, calcium, cholesterol, glucose, urea, creatinine and gamma glutamyl transpeptidase (γGT) were found in the cystic fluids of different host origins although these differences were statistically insignificant compared with the hydatid fluids of sheep. However, the concentration of triglycerides and proteins were significantly elevated in the cyst fluids of sheep compared with the other fluids studied. Similarities in the biochemical composition of different hydatid cyst fluids suggest the existence of sheep strains of *E. granulosus* in human and other domestic animal intermediate hosts in Libya.

Introduction

Human cystic echinococcosis, caused by the larval stage of *Echinococcus granulosus*, is recognized globally as an increasing major zoonotic disease and remains a significant health problem in Arab countries (Dar & Al-Karmi, 1997). Taxonomic consideration of *E. granulosus* based on morphological criteria in differentiating between intraspecific strains has been questioned (Bowles & McManus, 1993a) and is a matter of controversy and some confusion (Bowles & McManus, 1993b; Thompson *et al.*, 1994). However, biochemical studies are useful in differentiating strain variations of *E. granulosus* in different countries (Kumaratilake *et al.*, 1979; McManus & Macpherson, 1984). The strain characterization is particularly important in regions where more than one species of livestock intermediate host exists and where there is the possibility of different cycles of transmission and sources of infection for humans (Thompson, 1995). The intraspecific variants of *E. granulosus* are known to vary in their infectivity to the intermediate as well as the definitive hosts (Smyth, 1977).

Hydatidosis is endemic in Libyan Arab Jamahiriya, where many dometic animals, including sheep, goats, camels and cattle, act as intermediate hosts of *E. granulosus* (Dar & Taguri, 1979; Gebreel *et al.*, 1983). In Libya, the high prevalence of cystic echinococcosis in sheep and the high fertility rate of cysts shows that the sheep–dog strain of *E. granulosus* is widespread in the farmed areas (Gusbi *et al.*, 1987) and confirms high levels of infection in local dogs (Gusbi, 1987). Biochemical studies on hydatid cysts from different host origins (animals and humans) can provide valuable information for characterizing and determining the existence of strains of *E. granulosus* in this country. Thompson & Lymbery (1991) have also suggested that studies on strain variations of *Echinococcus* have epidemiological significance for the hydatid disease.

Since little work on the biochemical aspects of cystic echinococcosis in Libya has previously been undertaken (Sultan Sheriff *et al.*, 1984, 1989), the present study aims to evaluate the biochemical profiles of hydatid cyst fluids from different hosts (sheep, goats, camels,

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https://doi.org/10.1017/S0022149X00700526 Published online by Cambridge University Press

cattle and human) for the identification of strain variations of *E. granulosus*.

Materials and methods

Hydatid cyst fluids

Five samples of hydatid fluids were collected from the liver cysts of each host, i.e. sheep, goats, camels, cattle and humans. Hydatid cyst fluids originating from humans were obtained after surgical removal of cysts from patients at Al-Jallah Surgical Hospital, Benghazi, whereas the cyst fluids derived from the domestic animals were collected from the official abattoir of Benghazi. All cyst fluids were centrifuged at 15,000 rpm at 4°C for 30 min and the supernatants analysed for various biochemical parameters.

Biochemical analysis

Sodium and potassium were estimated by the Beckman's E_2A/ISE system. Calcium was determined by the CPC-dye binding method, triglycerides by the UV kinetic method, cholesterol by the CHOD-PAP method, glucose by the glucose oxidase method, urea by the urease-Berthelot reaction, uric acid by the enzymatic-colorimetric method, creatinine by Jaffe's method, protein by the Coomassie blue-dye binding method and gamma glutamyl transpeptidase by the Szasz method. All these parameters were estimated by commercially available diagnostic kits from Boehringer Mannheim GmBH, Germany.

Results

The biochemical analyses of the cyst fluids from the various hosts are shown in table 1. Sheep hydatid cyst fluids contain significantly more triglycerides ($P < 0.05$) and proteins ($P < 0.001$) than those in other hosts. However, the quantity of uric acid was found to be significantly more ($P < 0.05$) in human cyst fluids compared with those from other species.

Discussion

Inorganic and organic substances within hydatid cysts play a definitive role in the physiology, metabolism and immunology of cystic echinococcosis (Smyth, 1977; Frayha & Haddad, 1980; Sultan Sheriff *et al.*, 1984; Richards *et al.*, 1987; Chowdhury & Singh, 1993). Gamma glutamyl transpeptidase (γGT) is a membrane localized enzyme which plays a prominent role in the transport of amino acids and peptides across the cell membrane (Rambabu *et al.*, 1991). Interestingly, Thompson & Kumaratilake (1982) and McManus & Macpherson (1984) have reported that quantitative differences in the metabolism of *E. granulosus* and variations in the biochemical composition of hydatid fluids reflect strain variations in different intermediate hosts. Moreover, the development of the same strain or species of *Echinococcus* in different species of intermediate hosts may also cause shifts in the metabolism essential for parasite survival in different environments (Thompson, 1991).

Table 1. Biochemical profiles of hydatid fluids collected from different hosts infected with cystic echinococcosis (mean ± S.E., n = 5).

Host origin	mmol l^{-1}								Creatinine μmol l^{-1}	Protein g l^{-1}	Gamma glutamyl transpeptidase (γGT) IU l^{-1}
	Sodium	Potassium	Calcium	Triglycerides	Cholesterol	Glucose	Urea	Uric acid			
Sheep	113.60 ± 16.26	6.10 ± 0.51	2.75 ± 0.25	0.32 ± 0.04	1.23 ± 0.13	3.61 ± 0.23	126.50 ± 20.47	1.69 ± 0.07	17.68 ± 2.77	2.80 ± 0.17	56.00 ± 6.29
Goat	133.66 ± 13.83	7.30 ± 0.54	3.24 ± 0.01	0.15 ± 0.02*	1.23 ± 0.19	3.94 ± 0.21	180.72 ± 21.34	1.69 ± 0.00	17.88 ± 3.17	1.60 ± 0.13**	50.50 ± 3.35
Camel	129.50 ± 10.50	7.95 ± 0.82	2.52 ± 0.32	0.18 ± 0.00*	1.18 ± 0.05	3.69 ± 0.16	111.44 ± 6.75	1.52 ± 0.05	22.10 ± 1.98	1.50 ± 0.22**	51.25 ± 1.12
Cattle	83.50 ± 14.34	5.60 ± 0.73	2.27 ± 0.07	0.18 ± 0.04*	1.47 ± 0.13	3.86 ± 0.30	125.00 ± 15.93	1.86 ± 0.14	15.02 ± 3.14	1.20 ± 0.17**	46.00 ± 3.37
Human	124.25 ± 18.70	5.20 ± 0.76	3.37 ± 0.17	0.17 ± 0.04*	1.38 ± 0.11	4.32 ± 0.31	153.37 ± 22.53	2.54 ± 0.19*	22.98 ± 2.00	1.20 ± 0.04**	48.00 ± 2.17

*$P < 0.05$; **$P < 0.001$.

https://doi.org/10.1017/S0022149X00700526 Published online by Cambridge University Press

In the present study, we compared biochemical profiles of hydatid cyst fluids in the natural intermediate host (sheep) with the cyst fluids in other domestic animal intermediate hosts (goats, camels and cattle) and humans, which may help in the identification and characterization of strains of *E. granulosus* prevailing in Libyan Arab Jamahiriya. There was no significant difference between the concentrations of inorganic elements found in the cyst fluids from different host origins of *E. granulosus* (table 1). In support of this, biochemical studies have shown that the composition of various inorganic substances in sheep and human hydatid cyst fluids are similar (Sultan Sheriff *et al.*, 1984). The levels of triglycerides and proteins were found to be significantly lower in the cyst fluids of goats, camels, cattle and humans compared with sheep, indicating that the levels of these parameters are not influenced by the former hosts. However, Sultan Sheriff *et al.* (1989) have demonstrated no marked quantitative differences in the protein and lipid contents of hydatid fluids from the sheep and human forms. We have found higher quantities of cholesterol in different types of hydatid cyst fluids. This observation differs from the findings of Sultan Sheriff & Ghwarsha (1985) and Sultan Sheriff *et al.* (1989), who reported comparatively low levels of cholesterol in sheep and human hydatid fluids and suggested that cholesterol increases as hydatid cysts degenerate. The concentration of uric acid was found to be significantly higher in the human hydatid fluids compared with other cyst fluids. The increased levels of uric acid in human hydatid fluids may be due to normally high uric acid levels in humans compared with domestic animals and/or may also indicate the degenerative changes in human hydatid cysts.

It is difficult to explain the nature and origin of γGT in hydatid fluids. The present study indicates that γGT activity in sheep hydatid cysts was higher than in the other types studied. The marginally reduced γGT activity in cattle and humans may be partly attributed to the decreased protein content in their hydatid cyst fluids. The elevation in γGT activity in all types of hydatid cyst fluids could be due to the local secretion of this enzyme by the germinal layer of the slow-growing cysts.

In the present study, quantitative similarities in the biochemical profiles of hydatid fluids in cystic echinococcosis from hosts of different origin suggest the existence of sheep forms of *E. granulosus* in human and other domestic animal intermediate hosts in Libya. Molecular studies of Bowles & McManus (1993a) in China also report the existence of a common sheep strain, i.e. a homogenous strain of *E. granulosus* which infects sheep, cattle, camels, pigs and humans. Lymbery *et al.* (1990), Hope *et al.* (1991) and Bowles & McManus (1993a) have also reported the presence of a common sheep strain in Australia in various hosts including sheep, macropods, humans, pig, cattle and dingo. However, Bowles *et al.* (1992) and Bowles & McManus (1993b) identified two distinct strains of *E. granulosus* in Kenya, with the sheep strain occurring in sheep, goats, cattle, camels and humans, and the camel strain occurring in camels and occasionally goats. Moreover, Bowles *et al.* (1992) and Bowles & McManus (1993a) have also characterized sheep and horse strains of *E. granulosus* in the United Kingdom.

Camels are commonly infected in the Middle East and Africa, yet opinions differ with regard to the infectivity of *E. granulosus* of camel origin to humans (McManus *et al.* 1987; Eckert *et al.*, 1989; Wachira *et al.*, 1993). McManus & Rishi (1989) reported that the main causative agent for animal hydatidosis in Somalia is likely to be the camel strain of *E. granulosus*.

To justify the existence of a single sheep strain in Libya, further biochemical, molecular and epidemiological studies are necessary to confirm the strain differences in *E. granulosus*.

Acknowledgements

The authors are grateful to Professor Ibrahim M. Kashbur, Chairman of the Department of Microbiology and Parasitology, Dr Rajab S. Tobgi, Chairman of the Department of Laboratory Medicine Faculty of Medicine, Al-Arab Medical University, Benghazi, for their encouragement and Mr Gener R. Ronquillo for typing the manuscript.

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(Accepted 10 December 1998)