Epidemiol. Infect. (1993), **110**, 273–278

The role of management systems in the epidemiology of thermophilic campylobacters among poultry in Eastern zone of Tanzania

R. R. KAZWALA[1], S. F. H. JIWA[2] AND A. E. NKYA[1]

[1] *Department of Veterinary Medicine and Public Health,* [2] *Department of Veterinary Microbiology and Parasitology, Sokoine University of Agriculture, P.O. Box 3021, Morogoro, Tanzania*

(*Accepted 11 November 1992*)

SUMMARY

A total of 255 samples of droppings collected from a total of 22 different poultry units were examined for the presence of thermophilic campylobacters and the isolates biotyped using Skirrow's protocol. The organisms were isolated from 90 (35·3%) of all samples. Among the 22 units investigated, 13 (59%) were found to have unsatisfactory management systems, while 7 (32%) and 2 (9%) were found to have unsatisfactory and good systems respectively. Significantly large numbers of isolations, 68 of 147 (46·2%), were made from samples collected from poultry units with poor management ($P < 0{\cdot}005$), compared with 19 out of 84 (22·6%) samples which were collected from satisfactory units and 3 out of 24 (12·5%) samples collected from units exercising particularly good management. Nineteen of 72 (26·4%) samples collected from broilers, 32 out of 132 (24·2%) samples collected from layers and 39 out of 51 (76·49%) samples collected from indigenous free range poultry were positive for campylobacters. Among the 90 strains isolated from various units, 64 (70·1%) were *Campylobacter jejuni*, 25 (27·7%) were *C. coli*, and only 1 (2·2%) was *C. laridis*.

INTRODUCTION

Campylobacter jejuni has been widely acknowledged to be a leading cause of human gastroenteritis [1, 2], with number of cases comparable to or in excess of those due to salmonellas [3]. The organism is frequently isolated from the gastrointestinal tract of wild and domestic animal species, most of them being healthy carriers [4, 5]. They are also regularly isolated from caeca, intestinal contents, carcasses and droppings of poultry [6–9] in which there is no overt clinical disease. Human gastroenteritis, however, has clearly been linked to consumption of poultry excreting thermophilic campylobacters [2, 3, 10].

The source of thermophilic campylobacters in poultry is not clearly understood though the environment has been implicated [11, 12]. This study attempts to evaluate the role of management systems in the incidence and distribution of thermophilic campylobacters amongst poultry units in Tanzania, where the facilities available lack the sophistication available in more developed countries.

MATERIALS AND METHODS

Poultry farms visited

Twenty-two poultry units were investigated within the Eastern zone of Tanzania over which climatic conditions are fairly similar. The poultry were exotic layers and broilers of various breed types, and indigenous poultry were kept on the range.

Assessment of management

The following seven factors were assessed to provide scores for the management system of the individual farm: use of clean equipment; supply of fresh feed and water; use of fresh litter per batch coupled with disinfection of the house between batches; use of disinfectant foot baths; control of movement of attendants, owners and visitors in and out of the poultry houses or farms; vermin proof housing by provision of wire mesh on the windows, walls being crack proof and doors closing tightly; and assigning attendants to specific poultry houses. The type of husbandry, stocking policy, age and flock size in each unit were also recorded.

Scoring

Each farm unit was given our assessment based on one point for each of the above factors deemed satisfactory and none where it was not. The final mark was given by the formula $(x/7) \times 100(\%)$ where x was the total number of parameters practised by a poultry unit. The management system was arbitrarily assessed as follows: unsatisfactory, score $< 34\%$; satisfactory, score range 34–66%; or good, score $> 67\%$.

Isolation and identification of bacteria

Samples of freshly voided droppings were collected during a total of three visits to each farm over a period of 6 months. During each visit four pooled samples were collected from the unit in sterile plastic bags and stored in a cool box. Samples were processed within 2 h of collection, streaked onto blood free charcoal base campylobacter medium (CCDA, Oxoid CM 739, Oxoid Ltd, Basingstoke, UK), and incubated at 42 °C for 48 h in anaerobic jars containing campylobacter gas packs (Oxoid BR56, Oxoid Ltd, Basingstoke, UK). Identification and biotyping were carried out as described by Skirrow and Benjamin [13].

Statistical analysis

Chi-square test (χ^2) as described by Dunn [14] was used to test the significance of difference in isolation rates obtained under the different management systems.

RESULTS

Table 1 provides details of the 22 poultry units investigated. The management of 59% of the units surveyed was judged to be unsatisfactory, 32% to be satisfactory and 9% to be good (Table 2).

https://doi.org/10.1017/S0950268800068205 Published online by Cambridge University Press

Table 1. *Identification and records of individual poultry units*

Poultry units identification no.	Type of husbandry	Age of birds (months (m); weeks (w))	Flock size
1a	Layer	12 m	150
1b	Layer	12 m	180
2	Layer	16 m	85
3	Layer	13 m	300
4	Layer	10 m	210
5	Broiler	10 m	90
6	Layer	4 m	380
7	Broiler	8 w	280
8	Layer	13 m	80
9	Layer	14 m	280
10	Indigenous*	10 m	30
11	Indigenous	12 m	20
12	Layer	12 m	80
13	Broiler	8 w	70
14	Broiler	7 w	60
15	Broiler	3 w	85
16	Layer	13 w	90
17	Broiler	6 w	80
18	Layer	14 m	100
19	Indigenous	10 m	8
20	Indigenous	6 m	12
21	Indigenous	11 m	7

* All indigenous poultry were kept on free range.

Data on the isolation of campylobacters from the various units are presented in Table 3. Nineteen out of 72 (26·4%) samples collected from broilers, 24·2% of 132 samples collected from layers, and 39 out of 51 (76·4%) samples collected from indigenous poultry were positive for campylobacter. There is thus a significantly higher isolation rate from indigenous birds compared with exotic broilers and layers kept intensively ($P < 0{\cdot}005$). Further, there is a strong correlation between an unsatisfactory management system and a high isolation rate of thermophilic campylobacters; 68 of 147 (46·2%) compared with 22·6% (19/84) and 12·6% (3/24) of samples collected from units with satisfactory and good management systems respectively.

Using the Skirrow and Benjamin protocol [13], 64 of 90 (70·1%) isolates were identified as *C. jejuni*, 25 (27·7%) as *C. coli* and 1 (2·2%) as *C. laridis*.

DISCUSSION

There is abundant evidence that chickens commonly carry thermophilic campylobacters and that most commercially processed birds are contaminated (15–17). The epidemiology of campylobacter infection among poultry in farms is not clearly understood. Because potential sources and modes of transmission of infection are numerous and include, for example, the hygienic practices of attendants, the presence of flies and the re-use of old litter [10, 15, 16], parameters relevant to these factors were chosen. More than half of the poultry units surveyed were performing poorly and only two poultry units were judged to be good.

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Table 2. *Management parameters for score point gradation of the 22 poultry units studied*

Assessment factors	Poultry units											
	1a	1b	2	3	4	5	6	7	8	9	10	11
Use of clean equipment	+*	−	+	−	+	+	−	−	−	−	−	+
Supply of fresh water & feed	+	+	+	−	+	+	+	+	+	+	−	−
Use of fresh litter	+	+	+	+	+	+	+	+	+	+	na	na
Use of disinfection foot bath	−	−	+	+	−	−	−	−	−	−	−	−
Assigning attendants to specific poultry houses	−	−	+	−	−	+	+	−	+	+	−	+
Control of movement in & out of poultry houses & farm	−	−	−	−	−	−	−	−	−	−	−	−
Vermin proof housing (rodents, insects & wild birds)	−	−	+	+	+	+	−	−	−	+	−	−
Score (S) %†	42	29	86	42	57	71	42	29	42	57	−	−
General score‡	2	1	3	2	2	3	2	1	2	2	1	1

	Poultry units									
	12	13	14	15	16	17	18	19	20	21
Use of clean equipment	−	−	−	−	−	+	−	−	−	−
Supply of fresh water & feed	−	−	−	−	−	+	−	−	−	−
Use of fresh litter	+	+	+	+	+	+	+	na	na	na
Use of disinfection foot bath	−	−	−	−	−	−	−	−	−	−
Assigning attendants to specific poultry houses	+	+	−	−	−	−	−	−	−	−
Control of movement in & out of poultry houses & farm	−	−	−	−	−	−	−	−	−	−
Vermin proof housing (rodents, insects & wild birds)	−	−	−	−	−	−	−	−	−	−
Score (S) %†	29	29	14	14	14	42	14	−	−	−
General score‡	1	1	1	1	1	2	1	1	1	1

* +, yes; −, no; na, not applicable.

‡ 1, Unsatisfactory management; 2, Satisfactory management; 3, good management.

† S, total number of (+)/number of parameters (7) × 100; if S = < 33%, general score = 1; S = 34–66%, general score = 2; S = > 67%, general score = 3.

Our findings also show a significantly high isolation rate of thermophilic campylobacters among indigenous reared poultry ($P < 0{\cdot}005$) where clean equipment was not provided and houses were rarely cleaned between batches. The isolation rates in intensively or semi-intensively reared layers or broilers correlated with the degree of hygiene practised. The size of the flock and age of birds did not relate to isolation rates. While poultry flocks in Tanzania are very small in size

https://doi.org/10.1017/S0950268800068205 Published online by Cambridge University Press

Table 3. *Biotype identification of campylobacters and related isolation rates*

Poultry unit	Total samples collected	Campylobacter positive (%)	Biotypes		
			C. jejuni	*C. coli*	*C. laridis*
1a*	12	3 (25·0)	1	2	–
1b*	12	3 (25·0)	1	2	–
2	12	3 (25·0)	2	1	–
3	12	3 (25·0)	2	1	–
4	12	8 (66·7)	5	2	1
5	12	0 (0)	–	–	–
6	12	0 (0)	–	–	–
7	12	7 (58·3)	3	4	–
8	12	0 (0)	–	–	–
9	12	0 (0)	–	–	–
10	12	6 (50·0)	6	–	–
11	12	9 (75·0)	7	2	–
12	12	4 (33·3)	3	1	–
13	12	4 (33·3)	4	–	–
14	12	2 (81·0)	1	–	–
15	12	2 (66·6)	1	1	–
16	12	4 (33·3)	3	1	–
17	12	5 (41·6)	5	–	–
18	12	4 (33·3)	3	1	–
19†	3	3 (100·0)	2	1	–
20	12	11 (91·6)	7	4	–
21	12	10 (83·3)	8	2	–
Total	255	90 (35·3)	64 (70·1%)	25 (27·7%)	1 (2·2%)

* Two units were under same management.
† This unit was visited only once.

compared with those found in developed countries, there is little difference in the contamination rates with campylobacters between the two.

The distribution of biotypes of thermophilic campylobacters isolated throughout this study is similar to those found by other workers (5–8). That birds reared on a free range are more likely to acquire thermophilic campylobacters supports the suggestion that *C. jejuni* in wild birds, rodents and other animals maintain the infection in poultry, when birds are exposed to the organisms through contact, drinking contaminated surface water [18] or by feeding on carrier insects [19]. Further, faeces of domestic animals, fish and poultry offals which are known to contain campylobacters [21] are likely to be a potent source of infection to indigenous poultry who in most cases are scavengers. Of the two poultry units found to be practising good management, birds were caged without direct and with only limited indirect contact to the outside. Problems may still arise in such units from other routes, such as through contaminated attendants who fail to wear protective clothing or to use the disinfectant foot bath upon entering poultry houses.

The data presented suggest a direct correlation between the acquisition of campylobacters by poultry in Tanzania and certain features of the management of flocks. Clearly those that are confined either as broilers or layers fare better than those allowed to roam more freely, indicating a likely input from the natural

environment. The factors investigated in the intensively reared group of flocks are designed to control encroachment from the environment and are all of a kind that can be practised in countries in which for various reasons expensive and sophisticated equipment is unlikely to be available. The apparent success of those management systems operating the greatest number of preventive measures indicates the value and effectiveness of making and, hopefully, acting on assessments of this kind, particularly in developing societies.

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