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OVERVIEW OF *CAMPYLOBACTER* IN POULTRY, OTHER ANIMAL SPECIES AND IN MEAT IN REFERENCE TO MALAYSIA

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SUMMARY

This paper gives an overview on the prevalence of *Campylobacter* in Malaysia in chickens, other food animals, some pet animals as well as in meat from several studies that were carried out over a number of years. The organisms are found to be widespread in poultry. *Campylobacter jejuni* is frequently isolated in poultry compared to other species. The public heath importance as well as the factors influencing colonization in chickens and contamination of chicken carcasses are briefly discussed.

Keywords: *Campylobacter*, poultry, prevalence, public health importance.

INTRODUCTION

To date, there are 14 "validly described" species belonging to the genus *Campylobacter* (Vandamme, 2000). Many species are commonly found as commensals in the intestines of a wide variety of wild and domestic animals including birds and poultry; they are also found in shellfish and water. Table 1 refers to the various species of *Campylobacter. Campylobacter fetus* subsp. *venerealis* are found in semen and prepuce of bulls and genital tract of cows while *C. fetus* subsp. *fetus* in genital tract of sheep. *Campylobacter sputorum* are also found in the genital tract of bulls (Vandamme, 2000). A number of species are found in human oral cavity. *Campylobacter jejuni, C. coli and C. lari* colonise primarily the lower portion of the intestinal tract – caeca, large intestine and cloaca being the principal sites. They show mucus colonisation – in the mucus found on the outer surface and within the crypts, in particular caecal crypts; they are attracted to and metabolise mucin present in mucus. Campylobacters do not attach to crypt microvilli, they are highly motile and move freely in the crypt mucus; they are relatively fragile, sensitive to exposure to air, drying, low pH, heating. It has been reported that attached campylobacters are more resistant. *Campylobacter upsaliensis* and *C. hekveticus* have been isolated from cats and dogs whereas *C. hyointestinalis* and *C. mucosalis* mainly from pigs.

Table 1: *Campylobacter* species and their sources

Species or subspecies	Recognised sources
C. jejuni subsp. *jejuni*	Poultry, cattle, wild birds, pigs, water, cats, dogs
subsp. *doylei*	Human
C.coli	Pigs, poultry, cattle, wild birds, cats, dogs
C. lari	Cats, dogs, chickens, monkeys, seals, mussels, oysters, river water, seawater, gulls,
C. fetus subsp. *fetus*	Cattle, sheep
subsp. *venerealis*	cattle
C. hyointestinalis	
subsp. *hyointestinalis*	Pig, cattle, hamsters
subsp. *lawsonii*	Pigs, birds including poultry
C. upsaliensis	Cats, dogs, ducks, monkeys
C. helvaticus	Cats, dogs
C. mucosalis	Pigs
C. sputorum	
bv. *sputorum*	Human, cattle, pigs, sheep
bv. *faecalis*	Cattle, sheep
bv. *paraureolyticus*	Human, cattle
C. rectus	Human
C. gracilis	Human
C. showae	Human
C. conciscus	Human
C. curvus	Human

Source: Vandamme, 2000; Lastovica and Skirrow, 2000.

Campylobacters are mostly slender, spirally curved rods and are motile with a characteristic cockscrew-like movement. They are said to exist as viable, non-culturable (VNC) forms with coccoid morphology when stressed or in aged cultures, in a state of dormancy; in such a state, they could only be detected in drinking water as clumps in biofilms using IFA technique.

PUBLIC HEALTH IMPORTANCE OF *CAMPYLOBACTER*

Currently, the pathogenic species reported for man include *Campylobacter jejuni, C. coli, C. lari, C. upsaliensis, C. fetus (occasionally) and C. hyointestinalis. Campylobacter* causes enteritis in man which cannot be distinguished clinically from *Salmonella* or *Shigella* infection; symptoms include diarrhoea (may contain blood), fever, abdominal pain. The infection is self-limiting, lasts 2-5 days or up to 10 days. In some cases, it tends to be more severe and mimics acute appendicitis. Less frequently reported was bacteraemia and septic arthritis. The infective dose is about 500-800 cells. In human, erythromycin followed by ciprofloxacin seem to remain the drug of choice for campylobacteriosis

Since 1989, in USA, Canada and UK, the isolation rates for *Campylobacter* surpassed that for *Salmonella* as the most common agent for diarrhoeal cases. In USA, it is estimated that there are 1-4 million cases of *Campylobacter* infection with 200-730 deaths annually; in developing countries, it was reported as 30-50 times higher. In Malaysia and Singapore, the few published reports give a low isolation rate of *Campylobacter,* 3 to 5%; however according to Puthucheary *et al.* (1994), the true incidence may be 5-10 times greater than that of the industrialised countries.

In USA and England, the annual incidence of *Campylobacter* enteritis in children is higher, approximately 300/100,00 for children 1 to 4 years old whereas in developing countries the figures are even higher, such as in Thailand and Mexico, at 40,000 / 100,000 for children < 5 years old (Oberhelman and Taylor, 2000). Koe *et al.* (1991) in his work on diarrhoea in 97 Malaysian children (age 6 days – 4.5 years) found the causes to be *Salmonella* (25%), rotavirus (9%), *Aeromonas* (5%) *Campylobacter* (3%) and others (<2%). It was reported that 47% of the households had pets whereas 26% had no pets. Marquis *et al.* (1990) reported that children in families that kept chickens were 12 times more likely to contract *Campylobacter* enteritis compared to households without chickens.

Occasionally, complications occur with serious sequelae – septicaemia, reactive arthritis, meningitis, recurrent colitis, acute cholecystitis, Guillain-Barre' syndrome, Reiter's syndrome (Smith, 1995; Nachamkin *et al.*, 2000). Of these, Guillain Barre' syndrome (GBS) has a more interesting association and is more commonly reported; it is an acute inflammatory demyelinating polyneuritis marked with paralysis, pain and wasting muscles . The following was reported by Nachamkin *et al.* (2000) on GBS in USA - that 30% of patients with GBS had recent evidence of *Campylobacter* infection (1-3 weeks after infection), GBS occurs more commonly in males than females (3 to 1), occurs in patients of all ages and GBS following *Campylobacter* infection appeared to be more severe and more likely to involve axonal injury. Although the risk of developing GBS following *C. jejuni* infection is low (in USA, approximately 1 case of GBS per 1058 cases of *C. jejuni* infection), in one outbreak of gastroenteritis affecting 5000 persons, 16 developed GBS (Nachamkin *et al.*, 2000).

Reiter's syndrome is a subtype of reactive arthritis with a triad of symptoms - arthritis, urethritis, conjuctivitis; it is a sterile arthritis triggered by either enteric or urethral infections and occurs 7- 30 days after infection and can last for 4- 5 months or become chronic. Besides *Campylobacter* and *Salmonella*, other organisms that may trigger are *Shigella* and *Yersinia.*

Man mainly acquire campylobacteriosis through consumption of undercooked poultry meat, raw milk or untreated surface water ; as well as through contact with poultry, cattle or their products as well pet animals. Several studies and reports identified poultry meat as the vehicle or source of infections in man. Consumption of cooked foods cross-contaminated with kitchen utensils, hands, cutting boards, raw foods can also cause infection in man. According to Deming *et al.* (1987), consumption of undercooked poultry meat is a significant risk with odds ratio (OR) of 49 against 7.2 if cooked meat was consumed. Employment in poultry processing plants and abattoirs may predispose workers to *Campylobacter* enteritis; 27-68% of these workers had complement fixation antibody to *Campylobacter* as compared to 3% in rural field labourers (Jones and Robinson, 1981).

OCCURRENCE OF *CAMPYLOBACTER* IN FOOD ANIMALS, POULTRY AND MEAT

Several studies have reported the prevalence of *Campylobacter* in broiler chickens ranging from 6 – 100%; ducks 3 – 100%; turkeys 16 – 76%; quails 17.4% and ostriches, 19%. A number of studies was carried out in Malaysia in various poultry species as shown in Table 2.

OCCURRENCE OF *CAMPYLOBACTER* IN OTHER ANIMALS AND BIRDS

The prevalence of *Campylobacter* in cattle, sheep, goats were reported at 5 – 23%, 2 –28%, 15% respectively; in pigs, 50 – 69%; in lab. animals, 38 – 75% and in rats, 87%. In flying birds, such as pigeons, it was reported at 13 – 26.2% , in crows, 34 – 89.8% and seagulls, 43%. In dogs and cats, prevalence of *Campylobacter* was reported at 0.5 – 4% and 7- 45%, respectively.

43.2 – 50.7% of house flies carried campylobacters (Rosef and Kapperud, 1983; Shane *et al.*, 1985).

Table 2: Prevalence of *Campylobacter* sp. in poultry in Malaysia

Authors	Poultry species and prevalence			*Campylobacter* species
	Species (No. of farms or owners)	No. of samples	Percentage positive	
Moh (2002)	Broiler chickens (1 farm) Village chickens (2 owner) Guinea fowls (1 owner) Turkeys (1 owner)	30 30 15 15	93.3% 8.9% 6.7% 0%	*C. jejuni* - 87.9% *C. coli* - 12.1%
Rohaidah *et al.* (1999)	Broiler chickens (3 farms) Village chickens (4 owners)	415 (100-145) 53 (11-18)	20 - 53% 8 - 27%	na
Saleha (2002)	Broilers (10 farms; 5000 – 22000 chickens per farm)	508 (25 – 90)	0 - 98.2% (72.6%)	*C. jejuni* - 73.2% *C. coli* - 26.8%
Saleha *et al.* (1995)	Village chickens (10 owners; 10 –30 chickens / owner)	138 (5 – 10)	81.9%	*C. jejuni* - 65.5% *C. coli* - 34.5%
Zeenathul (1994)	Broiler chickens (2 farms) Village chickens (2 owners)	68 70	96 -100% 44 - 56%	*C. jejuni* - 48%, *C. coli* - 51%
Saleha *et al.* (1997)	Broiler chickens in 3 poultry processing plants (before slaughter)	90	26.7- 56.7%	na
Joseph *et al.* (1989)	Poultry (colon / caecal swabs) from 4 different sources	44	72.7%	*C. jejuni* - 50% *C. coli* - 23%
Lim (1996)	Ducks (4 farms; from a backyard to a commercial farm)	129 (20 – 38)	18 - 75%	*C. jejuni* - 49% *C. coli* - 51%
Saleha *et al.* (1996)	Quails (3 farms; 1000 – 10000 birds per farm)	130 (20-30)	64 - 80%	na

na – not available

Table 3 shows the prevalence of *Campylobacter* in food animals other than poultry and also in birds and pet animals in Malaysia.

FACTORS ASSOCIATED WITH *CAMPYLOBACTER* COLONISATION IN POULTRY

Several studies reported that the vertical transmission of *Campylobacter* from mother hens through eggs to the chicks as very unlikely. The organisms are usually not isolated during the first 2-3 weeks after placement; some flocks remained free for up to 6 weeks or more; however there was some exceptions where campylobacters were isolated as early as 4-7 days old. The incidence tends to increase with age (Saleha *et al.*, 1998).

The presence of *Campylobacter* in poultry at the farms are due to horizontal transmission, mainly from the environment in and around the chicken houses as well as these factors – inadequately cleaned and disinfected houses and facilities, presence of pests such as rats, birds, insects (flies, beetles) and pets (dogs, cats) well as other animals, use of unchlorinated water, from workers through their footwear, clothing, hands and from litter. According to Kapperud *et al.* (1993), the risk of colonisation or infection is inversely proportional to the standard of biosecurity, that is the risk of colonisation increases with the use of undisinfected water, that dipping of boots in disinfectant before entering broiler house prevents or delays colonisation and control of pests and other animals reduces rate of colonisation in the chickens.

McKenna *et al.* (2001) reported that 57% of transport equipment which include vehicles, modules and transport crates were found contaminated after cleaning and disinfection (compared to 69% prior to cleaning and disinfection) and suggested that cleaning and disinfection are not adequately effective to remove *Campylobacter*. As such these facilities could possibly be sources of infection for chickens on the farms and during transit to the poultry processing plants.

FACTORS ASSOCIATED WITH CONTAMINATION OF CARCASSES WITH *CAMPYLOBACTER* DURING POULTRY PROCESSING

The processing steps may spread contamination from live birds to carcasses. Scalding carcasses at 58°C significantly reduced *Campylobacter* on chicken carcasses, however, defeathering evisceration and harvesting of giblets led to an increase in carcass contamination. Chilling using water immersion also saw a reduction in *Campylobacter* on carcasses (Saleha *et al.*, 1998). In their study on four major producers of chickens in USA, Stern *et al.* (2001) reported that after chilling, the proportion of *Campylobacter*-positive carcasses ranged from 21 – 40.9%.

In one study (Saleha *et al.*,1997) at three processing plant, knives, defeathering machine, eviscerating machine, workers' gloves, process water, scalding water and chiller were sampled. Also, chickens before slaughter, carcasses after each operation, that is after defeathering, evisceration, chilling, cutting and at packaging areas as well as frozen poultry parts were sampled. It was found that 27 - 57% of cloacal swabs from live chickens were positive while 33 - 100% equipments and gloves were contaminated; on process water: scalding water at 58°C was negative while scalding water at 52°C was 100% positive and chiller water was also 100% positive for *Campylobacter*. 20 - 40% of whole carcasses and cut-up parts at packaging area were contaminated and 11 - 33% of frozen poultry parts were positive for *Campylobacter*

Studies have shown that 56 - 98% of chicken carcasses were found contaminated with *Campylobacter* with contamination rates in beef at 24 -54% and in pork at 18 – 72%. Very few studies were done on carcasses or meat in Malaysia (Table 4).

Campylobacter survived better on chilled than frozen chickens, with counts of 10^5 and 10^3 cfu/g, respectively. It was reported that 68% of campylobacters in chilled carcasses compared to 16% in frozen carcasses can survive more than 18 days at 4°C. At –20°C, campylobacters are reported to remain viable for three months, with decline in counts (Yogasundram and Shane, 1986).

CONCLUSION

The contamination of meat products, in particular, poultry meat by *Campylobacter* appears to be a significant risk factor. To date, the control of *Campylobacter* in chicken populations is not as successful as in the control for *Salmonella*. Sources of infection in chickens are still controversial and debatable, although there is strong

Table 3: Prevalence of *Campylobacter* in animals other than poultry in Malaysia

Authors	Animal species and prevalence			*Campylobacter* species
	Animal species	No. of samples	Percentage positives	
Joseph *et al.* (1989)	Breeding bulls	697	0.6%	*C. fetus*
	Dogs	30	0%	
	Cats	9	0%	
Saleha *et al.* (2000)	Cats	59	25%	*C. coli* - 43%,
	Dogs	59	14%	*C. lari* - 35%
	(in 2 locations)			*C. jejuni* - 17%,
				C. upsaliensis - 4%
Saleha *et al.* (2001)	Flying birds (5 species)	127 (1 – 63)	18% (0 – 23.7%)	na
Khor (2001)	Hamsters (2 species)	85	0%	-
Chong (2001)	Crows	79	25.3%	na
Wong P.S., Elaine (2002)	Cattle	48	2.1%	*C. jejuni* - 75%
				C. coli - 25%
Tann, Connie, J. (2002)	Pigs	85	64.7%	*C. coli* - 100%

na – not available

Table 4: Prevalence of *Campylobacter* on poultry, beef and pig carcasses in Malaysia

Authors	Types of meat samples and prevalence			*Campylobacter* species
	Types of meat	No. of samples	Percentage positives	
Nazarina (1998)	Chicken carcasses from 3 types of markets	90	87% (83.3 – 100%)	*C. jejuni* - >50%
Saleha *et al.* (1997)	Chicken carcasses and parts in 3 poultry processing plants at 5 different processing sites	87	11.1 – 62.5%	na
Joseph *et al.* (1989)	Poultry carcass rinses from 4 different sources	44	31.8%	*C. jejuni* - 15.9%
				C. coli - 0%
Wong P.S., Elaine (2002)	Beef carcasses	48	8.3%	*C. jejuni* - 75%
				C. coli - 25%
Tann, Connie, J. (2002)	Pig carcasses	76	60.5%	*C. coli* - 100%

na – not available

evidence to suggests on horizontal rather than vertical transmission. Biosecurity measures can only provide a preliminary barrier. The organisms are said to be too ubiquitous in the environment to be totally eliminated. Competitive exclusion and probiotics have not been much of a success as in *Salmonella*; in the case of vaccination, effective vaccines strategies against *Campylobacter* have yet to be developed. Thus, secondary means of controlling *Campylobacter* in chickens are urgently required. Efforts must also be undertaken to minimise contamination of carcasses during and after processing. The sites where risk of occurrence of contamination on carcasses are high require proper handling and strict monitoring to ensure minimal contamination.

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RINGKASAN

CAMPYLOBACTER *PADA AYAM, HAIWAN LAIN DAN DAGING DI MALAYSIA*

Kertaskerja ini memberi gambaran berkenaan prevalens *Campylobacter* pada ayam, haiwan ternakan lain, haiwan kesayangan serta pada daging di Malaysia, yang diperoleh daripada berbagai kajian yang telah dijalankan selama beberapa tahun. *Campylobacter* didapati tersebar luas pada ayam. *Campylobacter jejuni* merupakan spesies yang paling sering dikenalpasti dibandingkan dengan spesies lain. Kepentingan *Campylobacter* terhadap kesihatan awam, faktor yang berperanan dalam kolonisasi *Campylobacter* pada ayam serta faktor yang dapat menyebabkan kontaminasi karkas ayam oleh *Campylobacter* ada dihuraikan dengan ringkas.