



International Journal of Molecular and Clinical Microbiology



Prevalence of *Arcobacter* species isolated from human and various animals in east of Turkey

Mehmet Nuri Acik*

Department of Microbiology, Faculty of Veterinary Medicine, University of Bingol, Bingol, Turkey

ARTICLE INFO

Article history:

Received 4 February 2016

Accepted 6 March 2016

Available online 1 June 2016

Keywords:

Arcobacter spp. human, cattle, goat, sheep, m-PCR

ABSTRACT

This study was conducted to determine presence and distribution of *Arcobacter* spp. by conventional culture and a multiplex PCR (m-PCR) in the intestinal content samples that are collected from the cattle, sheep and goats and in the faecal samples of people who referred to the hospitals in the east of Turkey, because of complains about gastroenteritis and diarrhea. In the examination of the total 800 samples, containing 200 swab samples from each of animal species (cattle, sheep and goat) and 200 human faecal samples, *Arcobacter* spp. were isolated from 2.25 % (18/800) of the samples. The isolated *Arcobacter* strains were identified by genus and species specific PCR assays. The isolation percentages were calculated as 2.12% (17/800) for *A. butzleri* and 0.12% (1/800) for *A. cryaerophilus*. None of the human and animal samples were found to be positive for *A. skirrowii*. In conclusion, this report confirmed that the presence of *Arcobacter* species in human and various animals faecal samples in the east of Turkey. In addition, the present study is the first study to demonstrate the existence of *A. butzleri* and *A. cryaerophilus* in goats intestinal content samples in Turkey.

1. Introduction

Arcobacter is a genus previously known as aerotolerant *Campylobacter*, have recently been considered emergent enteropathogens and potential zoonotic agents (Ho et al., 2006). Currently, the genus *Arcobacter* contains 21 species of which three (*Arcobacter butzleri*, *A. cryaerophilus* and *A. skirrowii*) have emerged in recent years as potential human pathogens and associated with gastrointestinal infections (Collado and Figueras, 2011). In particular, *A. butzleri* has been linked with several cases of gastrointestinal diseases, with diarrhea being the main symptom in humans (Kiehlbauch et al, 1991; On et al.1995). Among *Campylobacter* spp. and related organisms, *A. butzleri* has been described as the fourth most prevalent pathogen found in diarrhoeic samples (Figueras et al.,

2014; Fernandez et al., 2015). In addition, it has been reported that *Arcobacter* spp. were isolated from faecal samples of clinically healthy animals including poultry, cattle, swine etc. as well as from variety of foods and water sources (Rice et al., 1999; Ongor et al., 2004; Grove-White et al., 2014; Girbau et al., 2015).

Despite of the range of the isolation methods used previously, no single standard method for the isolation of *Arcobacter* spp. from faecal samples has been established. Numerous selective media for the isolation of arcobacters have been described, almost all containing several antibiotics as inhibitory agents. A different approach, involving the passage of motile *Arcobacter* through a membrane filter onto a nonselective growth agar medium, is recognized as allowing the isolation of *Arcobacter* sensitive to antibiotics incorporated

*Corresponding author: Dr. Mehmet Nuri Acik
E-mail address: mnacik@bingol.edu.tr

into the selective media (Ongor et al., 2004; Hamill et al., 2008). The major drawback of this technique is the labor-intensive character of the method, the lower sensitivity of the medium compared to conventional selective media, and overgrowth of plates by competing fecal contaminants such as bacteria in Enterobacteriaceae family (Aspinall et al., 1993; Lopez et al., 1998). As a consequence, the use of a selective agar and the filter method in combination is recommended to optimize recovery of arcobacters from faecal samples (Ongor et al., 2004). Due to the difficult phenotypic characterization of *Arcobacter* spp., DNA-based methods as PCR currently have been reported for identify of arcobacters at genus and species level (Harmon and Wesley, 1997; Houf et al., 2000). m-PCR (targeting the 16S and 23S rRNA genes), was developed for the simultaneous detection and identification of *A. butzleri*, *A. cryaerophilus* and *A. skirrowii* by Houf et al. (2000).

Information on the presence of arcobacters in various sources in Turkey is limited, so the present study was conducted to determine the prevalence of *Arcobacter* spp. isolated from different animals and human in east of Turkey. According to our knowledge, the present study is the first report of the isolation of *Arcobacter* spp. from goat intestinal content samples.

2. Materials and Methods

2.1. Samples collection

A total number 800 samples were collected from various sources including of intestinal contents samples of animals (cattle, sheep, goats) (200 each) slaughtered at a local abattoir in the east of Turkey; faecal samples of people (200) who referred to the local hospitals with the complaints of gastroenteritis and diarrhea. Faecal samples were obtained from human using sterile cotton swabs. The intestinal contents were also collected from the lumen of the intestine. The swab samples were transferred to the laboratories within tubes containing 0.9% NaCl under cool conditions (at 4 °C).

2.2. Isolation of *Arcobacter* spp.

Faecal samples were examined according to the method described by Ongor et al. (2004). Briefly, samples were homogenized

by vortexing and aseptically inoculated into 10 ml Brucella broth (Difco, Detroit, MI, USA) containing Cefoperazone – Amphotericin – Teicoplanin (CAT) supplement (SR174E, Oxoid, UK) described by Atabay and Corry (1998). All enrichment samples were incubated for 48 h at 30°C under aerobic conditions. The enriched samples were dispensed using a micropipette onto 0.45µ pore size cellulose acetate filter laid on the surface of a Muller-Hinton Agar (CM337, Oxoid) with %5 lysed horse blood. The plates were incubated aerobically at 37°C for 1 h before filters were removed. Then the inoculated plates were incubated under aerobic conditions at 30°C for 48-72 h. The isolates were presumptively identified as *Arcobacter* spp. by colony appearance, microscopic morphology and motility. Then, Two or three pure colonies from each positive sample were selected for following experiments and stored at 20 °C in Nutrient Broth (CM067B; Oxoid) with 15% glycerol.

2.3. Multiplex-PCR (m-PCR) to detect *Arcobacter* at species level

Single colony from each isolate was used to extract bacterial DNA by the chloroform extraction method as described previously by Acik and Cetinkaya (2005) in Turkey. The PCR was performed in a gradient thermocycler (TC-512, Techne, UK) in a total reaction volume of 50 µl containing 5 µl of 10 X PCR buffer (750 mM Tris-HCl, pH 8.8, 200 mM (NH₄)₂SO₄, 0.1% Tween 20), 5 µl 25 mM MgCl₂, 250 µM of each deoxynucleotide triphosphate, 1.25 U of Taq DNA polymerase (MBI Fermentas, Hanover, MD, USA), 1 µM of each primer (Iontek, Bursa, Turkey) and 5 µl of template DNA. A pair of primers derived from 16S rRNA (Harmon and Wesley 1997) was first used to identify arcobacters at genus level. Then, positive DNA samples were examined further using three pairs of specific primers for *A. butzleri*, *A. cryaerophilus* and *A. skirrowii*, which were described by Houf et al. (2000) for differentiation at species level (Table 2). Amplification procedures used for both genus and species-specific PCR (m-PCR) were described previously (Harmon and Wesley, 1997; Houf et al., 2000). In the genus-specific PCR, products with the molecular size of 1223 bp and in the m-PCR, the sizes of 401, 257, 641

bp were considered indicative for identification as *Arcobacter* spp., *A. butzleri*, *A. cryaerophilus* and *A. skirrowii*, respectively. PCR amplicons were detected by electrophoresis in 2% (w/v) agarose gel and stained with ethidium bromide and then visualized using an ultraviolet transilluminator.

Reference *A. butzleri* (ATCC 49616), *A. cryaerophilus* (ATCC 43157) and *A. skirrowii* (ATCC 51132) strains were included as positive controls and distilled water was used as negative control in all assays.

2.4. Statistical analysis

A chi-squared (χ^2) test was used to estimate differences between the isolation rates of *Arcobacter* spp. in animals and human, whereby a probability of less than 0.05 was considered as statistically significant.

3. Results

Of the 800 faecal samples tested by conventional culture and PCR, 18 (2.25%) were detected to be positive for *Arcobacter* spp. the isolation rate of *Arcobacter* spp. determined to be the highest in the intestinal content samples of goat with 4% (8/200) and the lowest in the intestinal content samples of sheep with 1% (2/200). The distribution of isolation rates by sample and animal species is present in Table I.

In m-PCR analysis of DNA samples extracted from the colonies of 18 samples, *A. butzleri* was identified from 17 (94.4%). This proportion was calculated to be 2.1 % when the total number of 800 samples was considered. The presence of *A. butzleri* was found to be highest in intestinal content samples of human, sheep, cattle, followed by intestinal content samples of goat (87.5%). Only one goat sample yielded *A. cryaerophilus* whereas none of the sheep, cattle and human samples were found positive for *A. cryaerophilus*. In addition, no *A. skirrowii* were isolated and identified from samples of human and animals. No significant differences were found between the isolation rates of *Arcobacter* spp. obtained from animals and human ($P < 0.001$).

4. Discussion

Arcobacters have been isolated from many different sources such as animals and their

products, human and foods. In many studies, arcobacters have been associated with animal diseases including abortion, mastitis and diarrhoea (Vandamme De Ley, 1991; Lopez et al., 1998; Van Driessche et al., 2003; Hamill et al., 2008) and reproduction disorders (De Oliveira et al., 1997). *Arcobacter* species have been also isolated from clinically healthy animals and human (Houf et al., 2000; On et al., 2002; Rice et al., 1999). There is limited research on *Arcobacter* presence in goat samples. Shah et al. (2013) reported that none of the goat faecal samples was found to carry *Arcobacter* spp. On the contrary, 10.7% of faecal samples from goats were reported to be positive for *Arcobacter* by De Semet et al. (2007). In this study, the prevalence of *Arcobacter* spp. in the goat samples was relatively low, which is comparable to those by De Semet et al. (2007). Differences in *Arcobacter* prevalence in goat samples were also observed between other animals. The prevalence of *Arcobacter* in cattle samples in this study was lower to be prevalence found by Ongor et al. (2004) in Turkey and to prevalence previously reported by Fernandez et al. (2015) in Chile. Other studies have also reported the occurrence of arcobacters in clinically healthy cattle, with a prevalence varying from 3.6 to 40.1% (Harmon and Wesley, 1997; Golla et al., 2002; Kabeya et al., 2003; Van Driessche et al., 2003; Grove-White et al., 2014). In addition, previous studies reported high prevalence of *Arcobacter* spp. in sheep (Golla et al., 2002; Rivas et al., 2004). The prevalence of *Arcobacter* spp. in the sheep samples in this study 1%, which is lower than found in a previously study (Golla et al., 2002). A variety of factors, such as age, season, number of animals examined, type of samples and isolation methods, could be proposed to be responsible for the differences in the isolation rates of the agents. Shah et al. (2013) reported that prevalence of *Arcobacter* was showed in significant difference in detection rates between adult and young cattle. In addition, the prevalence of *Arcobacter* spp. isolated from water samples in winter was significantly higher than summer (Tazegul, 2010).

In Turkey, there are not records related the prevalence of *Arcobacter* spp. in human, due to not recognize the importance of *Arcobacter* for public health and not apply isolation and identification of agents in routine laboratory in

hospitals. In a study conducted at the local region in Turkey by Kayman et al. (2012), 9 out of 3287 human faecal samples (0,27%) were detected to be positive for *Arcobacter* spp. In the present study, the prevalence of *Arcobacter* species in human faecal samples (1.5%) was significantly higher to the prevalence found by Kayman et al. (2012). However, the prevalence of *Arcobacter* in this study was similar to the prevalence observed by Abeele et al. (2014) in Belgium (1.3%). Abeele et al. (2014) reported that prevalence of other intestinal pathogens *Campylobacter*, *Salmonella* and *C. difficile* was 5.6%, 2% and 1.6%, respectively. These results suggests that prevalence of *Arcobacter* in human was low compared to those of other foodborne pathogens and *Arcobacter* spp. were the fourth most common pathogen group.

Arcobacter butzleri has been described as the predominant species isolated from animals and human samples, and it was confirmed as the most prevalent agent in this study. 94.4% and 5.6% of the tested *Arcobacter* species were found to be positive for *A. butzleri* and *A. cryaerophilus*, respectively, whereas none of the examined samples were found positive for *A. skirrowii*. *Arcobacter cryaerophilus* was detected from only one goat samples in this study. To our knowledge, this is the first report in which in *A. cryaerophilus* was isolated from goat intestinal contents samples. The findings in this study were similar to results previously reported in the animals and human samples. Ongor et al. (2004) reported that prevalence of *A. butzleri*, *A. cryaerophilus* and *A. skirrowii* were found to be positive 7% , 2% and 0.7% of cattle faecal samples, respectively, in east of Turkey. In other studies, the high prevalence of the *A.*

butzleri in various animals and human was also reported by other authors (Rahmi, 2014; Yesilmen et al., 2014; Fernandez et al., 2015; Zacharow et al., 2015) Fernandez et al. (2015) reported that only *A. butzleri* was isolated (3.6%) from children with diarrhea and unable to recovery *A. cryaerophilus* and *A. skirrowii*. A number of factors such as the type and concentrations of antimicrobial compounds in media might influence the growth and isolation rate *Arcobacter* spp. in particularly, *A. cryaerophilus* and *A. skirrowii*. In addition, some changes in the isolation methods, such as cultivation under microaerobic conditions or the use of blood agar plates without any antibiotic, may improve the isolation rates of *A. skirrowii* and *A. cryaerophilus* due to these species are more difficult to culture than *A. butzleri*.

In conclusion, this report confirmed the presence of *Arcobacter* species in human and various animals faecal samples in the east region of Turkey. Therefore, they can play vital role in contamination of environment and food chain and pose a thtreat for human healthy. According to our knowledge, the present study is the first report of the isolation of *Arcobacter* spp. from goat faecal samples. In additon this is the first report in which in *A. cryaerophilus* was isolated from goat intestinal contents samples.

Acknowledgements

The technical support of Emine OKSUZ DURMAZ is gratefully acknowledged. This work was supported by the Scientific Research Council of Bingol University (BAP-72-119-2013)

Table 1. Results of culture and m-PCR

Type of samples	PCR and Culture results			m-PCR results	
	No. of samples	<i>Arcobacter</i> spp.	<i>A. butzleri</i>	<i>A. cryaerophilus</i>	<i>A. skirrowii</i>
Cattle	200	5 (2.5%)	5 (100%)	0	0
Sheep	200	2 (1%)	2(100%)	0	0
Goat	200	8 (4%)	7 (87.5%)	1(12.5%)	0
Human	200	3 (1.5%)	3 (100%)	0	0
Total	800	18 (2.25%)	17 (94.4%)	1 (5.6%)	0

P<0.001

Table 2. Primers used in this study.

Species	Primers	Sequences (5'-3')	PCR Products (bp)	References
<i>Arcobacter</i> spp.	Arco I Arco II	AGAGATTAGCCTGTATTGTATC TAGCATCCCCGCTTCGAATGA	1223	Harmon and Wesley, 1997
<i>A. butzleri</i>	BUTZ ARCO	CCTGGACTTGACATAGTAAGAATGA CGTATTCACCGTAGCATAGC	401	Houf et al., 2000
<i>A. skirrowii</i>	SKIR ARCO	GGCGATTTACTGGAACACA CGTATTCACCGTAGCATAGC	641	Houf et al., 2000
<i>A. cryaerophilus</i>	CRY1 CRY2	TGCTGGAGCGGATAGAAGTA AACAACCTACGTCCTTCGAC	257	Houf et al., 2000

Refereces

- Acik, M.N., Cetinkaya, B., 2005. The heterogeneity of *Campylobacter jejuni* and *Campylobacter coli* strains isolated from healthy cattle. *Lett Appl Microbiol.* 41(5):397-403.
- Aspinall, S.T., Wareing, D.R., Hayward, P.G., Hutchinson, D.N., 1993. Selective medium for thermophilic campylobacters including *Campylobacter upsaliensis*. *J Clin Pathol.* 46:829-831.
- Collado, L., Figueras, M.J., 2011. Taxonomy, epidemiology, and clinical relevance of the genus *Arcobacter*. *Clin Microbiol Rev.* 24(1):174-192.
- De Oliveira, S.J., Baetz, A.L., Wesley, I.V., Harmon, K.M., 1997. Classification of *Arcobacter* species isolated from aborted pig fetuses and sows with reproductive problems in Brazil. *Vet Microbiol.* 57(4):347-354.
- De Semet, S., Moerman, L., Houf, K., 2007. Fecal shedding of *Arcobacter* species in sheep and goat at farm level. *Zoo Pub Health.* 54:80.
- Fernandez, H., Villanueva, M.P., Mansilla, I., Gonzalez, M., Latif, F., 2015. *Arcobacter butzleri* and *A. cryaerophilus* in human, animals and food sources, in southern Chile. *Braz J Microbiol.* 46(1):145-147.
- Figueras, M.J., Levican, A., Pujol, I., Ballester, F., Rabada-quilez, M.J., Gomez-Bertomeu, F., 2014. A severe case of persistent diarrhoea associated with *Arcobacter cryaerophilus* but attributed to *Campylobacter* sp. and a review of the clinical incidence of *Arcobacter* spp. *New Microbes.* 2(2):31-37.
- Girbau, C., Guerra C., Martinez-Malaxetxebarria, I., Alonso, R., Fernandez-Astorga, A., 2015. Prevalence of ten putative virulence genes in the emerging foodborne pathogen *Arcobacter* isolated from foodproducts. *Food Microbiol.* 52:146-149.
- Golla, S.C., Murano, E.A., Johnson, L.G., Tipton, N.C., Cureington, E.A., Savell, J.W., 2002. Determination of the occurrence of *Arcobacter butzleri* in beef and dairy cattle from Texas by various isolation methods. *J Food Prot.* 65(12):1849-1853.
- Grove-White, D.H., Leatherbarrow, A.J., Cripps, P.J., Diggle, P.J., French, N.P., 2014. Temporal and farm-management-associated variation in faecal pat prevalence of *Arcobacter* spp. in ruminants. *Epidemiol Infect.* 142(4):861-870.
- Hamill, S., Neill, S.D., Madden, R.H., 2008. A comparison of media for the isolation of *Arcobacter* spp. from retail packs of beef. *J Food Prot.* 71(4):850-854.
- Harmon, K.M., Wesley I.V., 1997. Multiplex PCR for the identification of *Arcobacter* and differentiation of *Arcobacter butzleri* from other arcobacters. *Vet Microbiol.* 58(2-4): 215-27.
- Ho, H.T., Lipman, L.J., Gaastra W., 2006. *Arcobacter*, what is known and unknown about a potential foodborne zoonotic agent! *Vet Microbiol.* 115(1-3):1-13.
- Houf, K., Tutenel, A., De Zutter, L., Van Hoof, J., Vandamme P., 2000. Development of a multiplex PCR assay for the simultaneous detection and identification of *Arcobacter butzleri*, *Arcobacter cryaerophilus* and *Arcobacter skirrowii*. *FEMS Microbiol Lett.* 193:89-94.
- Houf, K., Stephan, R., 2007. Isolation and characterization of the emerging foodborn pathogen *Arcobacter* from human stool. *J Microbiol Methods.* 68(2): 408-413.
- Kabeya, H., Maruyama, S., Morita, A Y., Kubo, M., Yamamoto, K., Arai, S., Izumi, T., Kobayashi, Y., Katsube, Y., Mikam, T., 2003. Distribution of *Arcobacter* species among livestock in Japan. *Vet Microbiol.* 93(2): 153-158.
- Kayman, T., Abay, S., Hizlisoy, H., Atabay, H.I., Diker, K.S., Aydin, F., 2012. Emerging pathogen *Arcobacter* spp. in acute gastroenteritis: molecular identification, antibiotic susceptibilities and genotyping of the isolated arcobacters. *J Med Microbiol.* 61:1439-1444.
- Lopez, L., Castillo, F. J., Clavel, A., Rubio, M. C., 1998. Use of a selective medium and a membrane filter method for isolation of *Campylobacter* species from Spanish paediatric

- patients. Eur. J Clin Microbiol Infect. Dis. 17:489-492.
- On, S.L., Jensen, T.K., Bille-Hansen, V., Jorsal, S.E., Vandamme, P., 2002. Prevalence and diversity of *Arcobacter* spp. isolated from the internal organs of spontaneous porcine abortions in Denmark. Vet Microbiol. 85(2):159-167.
- Ongor, H., Cetinkaya, B., Acik M.N., Atabay, H.I., 2004. Investigation of arcobacters in meat and faecal samples of clinically healthy cattle in Turkey. Lett Appl Microbiol. 38(4):339-344.
- Rahmi, E., 2014. Prevalence and antimicrobial resistance of *Arcobacter* species isolated from poultry meat in Iran. Br Poult Sci. 55(2):174-80.
- Ramees, T.P., Rathore, R.S., Bagalkot, P.S., Sailo, B., Mohan, H.V., Kumar, A., Dhama, K., Singh, R.K., 2014. Genotyping and genetic diversity of *Arcobacter butzleri* and *A. cryaerophilus* isolated from different sources by using ERIC-PCR from India. Vet Q. 34(4):211-217.
- Rice, E.W., Rodgers, M.R., Wesley, I.V., Johnson, C.H., Tanner, S.A., 1999. Isolation of *Arcobacter butzleri* from ground water. Lett Appl Microbiol. 28(1):31-35.
- Rivas, L., Fegan, N., Vanderlinde, P., 2004. Isolation and characterisation of *Arcobacter butzleri* from meat. Int J Food Microbiol. 91(1):31-41.
- Shah, A.H., Saleh A.A., Zunita, Z., Murugaiyah, M., Aliyu, A.B., Jafri, N., 2013. Prevalence, distribution and antibiotic resistance of emergent *Arcobacter* spp. from clinically healthy cattle and goats. Transbound Emerg Dis. 60(1):9-16.
- Tazegül, E., 2010. Kars Bölgesindeki Su Kaynaklarından *Arcobacter* spp. izolasyonu ve Multipleks PCR ile İdentifikasyonu. Yüksek Lisans Tezi.
- Van Den Abeele, A.M., Vogelaers, D., Van Hende, J., Houf, K., 2014. Prevalence of *Arcobacter* species among humans, Belgium, 2008-2013. Emerg Infect Dis. 20(10):1731-1734.
- Van Driessche, E., Houf, K., Van Hoof, J., De Zutter, L., Vandamme, P., 2003. Isolation of *Arcobacter* species from animal feces. FEMS Microbiol Lett. 229(2): 243-248.
- Vandamme P., De Ley, J., 1991. Proposal for a new family, Campylobacteraceae. Int J Syst Bacteriol. 41:451-455.
- Vandamme P., Pugina, P., Benzi, G., Van Etterijck, R., Vlaes L., Kersters, K., Butzler, J.P., Lior, H., Lauwers, S., 1992. Outbreak of recurrent abdominal cramps associated with *Arcobacter butzleri* in an Italian school. J Clin Microbiol. 30(9):2335-2337.
- Wesley, I.V., Schroeder-Tucker, L., 2011. Recovery of *Arcobacter* spp. from nonlivestock species. J. Zoo Wildl Med. 42(3):508-512.
- Yesilmen, S., Vural, A., Erkan, M.E., Yıldırım, I.H., 2014. Prevalence and antimicrobial susceptibility of *Arcobacter* species in cow milk, water buffalo milk and fresh village cheese. Int J Food Microbiol. 188:11-14.
- Zacharow, I., Bystron, J., Walecka-Zacharska, E., Podkowik, M., Bania, J., 2015. Prevalence and antimicrobial resistance of *Arcobacter butzleri* and *Arcobacter cryaerophilus* isolates from retail meat in Lower Silesia region, Poland Pol J Vet Sci. 18(1):63-69.