Original Research Article
DOI: https://doi.org/10.62418/ijvph.9.2.2023.27-32

Characterization of Extended-spectrum and pAmpC Beta-lactamases producing *Escherichia coli* isolated from Chicken Meat in West Bengal

Tousif Mondal [(1)], Samir Dey [(1)], Indranil Samanta [(1)], Siddhartha Narayan Joardar [(1)], Aditya Paul [(1)], Sk. Sahanawaz Alam [(2)], Kunal Batabyal [(1)*]

[(1)] Department of Veterinary Microbiology, Faculty of Veterinary and Animal Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata – 37, West Bengal, India, [(2)] Microbiology Unit, Department of Botany, Garhbeta College, Paschim Medinipur, West Bengal

(Received: 18th October 2023 | Accepted: 11th November 2023)

Abstract

Escherichia coli is one of the pathogenic bacteria causing food-borne infections like chicken meat, which can lead to serious public health hazards. Antimicrobial resistance in *E. coli* is a serious threat to the human population nowadays. The present study aimed to detect extended-spectrum beta-lactamases (ESBLs) and AmpC beta-lactamase (ACBL)-producing *Escherichia coli* from chicken meat, from different districts of West Bengal. A total of 107 raw chicken meat samples were collected just after slaughter from different districts' local markets followed by isolation and identification of 74(69.16%) *E. coli* isolates by standard conventional and molecular methods. Among the positive isolates, 23(31.08%) were positive to ESBL production with the presence of the $bla_{\text{CTX-M}}$ gene, whereas 65(87.84%) strains were found to possess the bla_{AmpC} gene. Antibiogram study of ESBL-positive *E. coli* strains revealed the sensitivity of these strains to imipenem (65.65%), gentamicin (86.96%), ampicillin/sulbactam (78.26%), and amikacin (82.61%) whereas all other antimicrobials were resistant against these pathogens.

Keywords: Antibiogram, ACBL, CTX-M, Chicken meat, *E. coli*, ESBL

Introduction:

Meat production in India is growing day by day. Now, the annual meat production of India is 5.3 million metric tons which is the 5th largest in the World (DAHD, 2017). India has the world's largest livestock population which plays an important role in rural economy and livelihood. It produces 21% of global chicken meat production annually. The poultry industry is rapidly growing in India as well as in the state of West Bengal. West Bengal is the 2nd largest contributor with 640 thousand metric tons of meat production of which chicken meat production is 328 thousand metric tons (DAHD, 2017).But chicken meat can easily get spoilt with bacterial spoilage due to faulty handling, improper storage, and poor management of the birds (Dierikx et al., 2010).

Antimicrobial resistance (AMR) is increasing day by day. With the increased consumption of antibiotics, in the last few decades leading to a rise in their resistance among microbial populations. The incidence of extended-spectrum beta-lactamases (ESBLs)-producing *Escherichia coli* in food is quite significantly increasing nowadays all around the World. ESBL production in bacteria is governed by the presence of $bla_{\text{CTX-M}}$, bla_{SHV}, and bla_{TEM} genes which are easily transferred from one bacterium to another spreading the antimicrobial resistance. Among these resistance genes, the b$la_{\text{CTX-M}}$ gene is the most common gene associated with ESBL positivity in *E. coli* (Dierikx et al., 2010). This drug-resistant pathogen can create a major problem during their treatment forcing the clinicians to use newer and newer antibiotics (Tenover et al., 1999; Olesen et al., 2004).These antimicrobial resistance genes of *E. coli* are easily transferrable to other pathogens conferring them resistance. The AmpC beta-lactamase (ACBL) is the first bacterial enzyme reported to destroy penicillin in Gram-negative bacteria like *Escherichia coli*. ACBL encoding gene bla_{AmpC} is found in transmissible plasmids and also in bacterial chromosomes (Reich et al., 2013). ACBL-producing *E. coli* strains are resistant to broad-spectrum cephalosporins but their resistance patterns are less expressed *in-vitro* than that of the ESBLs (Jacoby, 2009).

Common people consider chicken meat as a very popular source of animal protein worldwide. ESBL-producing *E. coli* is frequently reported from chicken samples worldwide and may be pathogenic to humans causing urinary tract infections, septicemia, meningitis, etc. (Grami et al., 2013; Nandanwar et al., 2014). Most of the countries are using a large quantity of different antimicrobials to raise poultry which are also used in human treatments. Indiscriminate use of such essential antimicrobials in animal production is likely to accelerate the resistance development of pathogens, as well as commensal organisms like *E. coli*. This would result in

treatment failures and economic loss and could act as a source of the gene pool for transmission to humans (Castanon, 2007). In addition, there are human health concerns about the presence of antimicrobial residues in meat, eggs, and other animal products (Sahoo et al., 2010; Darwish et al., 2013).

Identification of potential MDR pathogenic bacteria is essential towards the development of better managemental procedures. With this background, the present research has aimed at the detection and characterization of ESBL and ACBL-producing *E. coli* from raw chicken meat collected from different local markets of West Bengal and followed by an *in-vitro* antibiogram to assess their resistance patterns.

Materials and Methods:

Sample collection: A total of 107chicken meat samples were collected at the time of slaughter from local markets of Paschim Medinipur, Nadia, and Hooghly district of West Bengal during the period of August to December 2022. Ten grams of fresh meat samples were aseptically collected in individual vials and transported (under ice cover) to the laboratory. Samples were enriched on the date of receiving in the laboratory.

Bacteriological isolation and characterization: A 10% homogenized suspension of each meat sample was prepared in sterile normal saline and streaked onto Mac Conkey's agar (Hi-Media, India) and then onto EMB agar (Hi-Media, India) plates followed by incubation overnight at 37°C. The chocolate colour colonies with a 'metallic sheen' were picked up for further morphological (by Gram's staining) and biochemical characterization (Carter and Wise, 2004; Quinn et al., 2011). One tentative *E. coli* isolate from each sample was taken in this study.

Confirmation of *Escherichia coli* by PCR: All the tentative *E. coli* isolates were confirmed by detection of the 16S*rRNA* gene specific for this genus, following the protocol of Wang et al., 1996 (Table 1).

Phenotypic detection of ESBL in *E. coli* strains: Phenotypic detection of ESBL activity of the *E. coli* isolates was done by double disc diffusion assay (Bauer et al., 1966) using both cefotaxime (30µg) and ceftazidime disks (30µg) and their clavulanate (10µg) discs as per CLSI method of Patel et al. (2015). An increase of zone diameter (>5mm) in each clavulanate disk than the single drug disk is treated as phenotypical confirmation of the ESBL activity.

Molecular detection of ESBL positivity: All the *E. coli* isolates were screened for ESBL positivity by the detection of the $bla_{CTX\text{-}M}$ gene by PCR assay as per the protocol of Weill et al. (2004) (Table 1). In this method, 5µl bacterial DNA templates, 50pmol of each primer, 200mM deoxynuc1eoside triphosphate, 1U Taq DNA polymerase (Promega, USA), 2mM $MgC1_2$, and 10% dimethyl sulfoxide (DMSO) was added in a 25µl reaction mixture and subjected to amplification with following PCR conditions - 10mins of initial denaturation at 94°C followed by 30s of denaturation at 94°C, 30s of annealing at 53°C and 1min of extension at 72°C for 35 cycles and 10mins of final extension at 72°C. The amplified product was visualized by gel documentation system (UVP, UK) after electrophoresis in 1.5% (w/v) agarose (SRL, India) gel containing ethidium bromide (0.5µg/ml) (SRL, India). In this study, an *Escherichia coli* serotype O2, maintained in the departmental laboratory was used as the positive control.

Phenotypical detection of ACBL Production in *Escherichia coli* isolates: *In-vitro* ACBL activity of all *Escherichia coli* isolates was examined following the protocol of Tan et al.(2009) by cefoxitin–cloxacillin double-disc synergy (CC-DDS) test.

PCR detection of *AmpC* gene in *E. coli* strains: All the *E. coli* strains were examined for the presence of the AmpC gene by PCR following the protocol of Feria et al., 2002 (Table 1). In this method, the total reaction volume was 25µl containing 5µl of bacterial DNA template, 100 pmol of each primer, 200 mM of each dNTP, 2mM $MgCl_2$, and 10% DMSO. The PCR mixture was subjected to an initial denaturation step of 5mins at 94°C; followed by 30cycles of amplification consisting of 30s of denaturation at 94°C, 30s of annealing at 57°C, 1min of elongation at 72°C and 10mins of final extension at 72°C. The PCR product was electrophoresed in 1.5% (w/v) agarose (SRL, India) gel containing ethidium bromide (0.5µg/ml) (SRL, India) and the gel was visualized in a gel documentation system (UVP, UK).

Antibiogram of ESBL-positive *E. Coli*s strains: *In-vitro* antibiotic sensitivity of the ESBL gene-positive *E. coli* isolates was examined using 10 commonly used antimicrobials *viz.* ampicillin, amikacin, ampicillin/ clavulanic acid, ampicillin/ sulbactam, cefotaxime, ceftriaxone, ceftazidime, gentamicin, imipenem, and norfloxacin by disc diffusion method (Bauer et al., 1966). Standard antibiotic discs (Hi-Media, India) were used as the source of antibiotics. The inhibition zone diameters were interpreted following the standard chart (Patel et al., 2015).

Table 1: Details of Target Genes and their Primers used in this Study			
Gene	**Primer sequence**	**Size**	**Reference**
E. coli 16S *rRNA*	ECO-1 F 5'GACCTCGGTTTAGTTCACAGA3'ECO-2 R 5'CACACGCTGACGCTGACCA3'	585 bp	Wang et al., 1996
bla_{CTX_M} consensus (ESBL)	CTX-M F 5' CCATGTGCAGCACCAGTAA 3' CTX-M R 5' CGCAATATCCTTGGTGGTG 3'	540 bp	Weill et al., 2004
bla_{AmpC} (ACBL)	AmpC F 5'CCCCGCTTATAGAGCAACAA3'AmpC R 5'TCAATGGTCGACTTCACACC3'	634 bp	Feria et al., 2002

Results and Discussion:

Approximately 74 (69.16%) chicken meat samples were tested to be positive for *Escherichia coli* in this study. All the isolates of *E. coli* were characterized by pinkish colonies on Mac Conkey's agar, characteristic 'metallic sheen' on EMB agar plates, Gram's negative rods, and positive reaction to the indole test. All the isolates were detected to possess the 16S *rRNA* gene (Figure 1) sterile EMB agar (Hi-Media, India) plates and thus confirmed to be *E. coli* (Carter and Wise, 2004; Quinn et al., 2011; Samanta, 2013). This study identified a very high prevalence (78.86%) of *Escherichia coli* in poultry meat, which matches with earlier works of Reich et al. (2013), Maciuca et al. (2015), and Klimiene et al. (2018) who reported 45%, 54% and 92% *E. coli* prevalence in chicken meat from different countries showing the significant presence of the pathogen in the food chain (Dierikx et al., 2010). Samples from the Hooghly district were mostly infected (79.17%) followed by Paschim Medinipur and Nadia (Table 2).

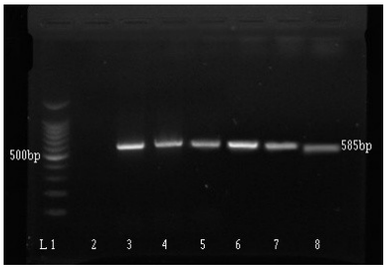

Figure 1: Detection of the 16S *rRNA* gene (585bp) in *E. coli* isolates by PCR (Lane 1: 100bp ladder, L2: uninoculated negative control, L3: positive control, L4-8: test samples)

A total of 18(24.32%) *E. coli* isolates were detected to be phenotypical ESBL producers; whereas 23(31.08%) isolates were found to possess the bla_{CTX-M} gene (Figure 2) by PCR. Again 57(77.03%) strains were positive to ACBL production and a total of 65(87.84%) *E. coli* isolates were confirmed to possess the bla_{AmpC} gene genotypically (Figure 3, Table 2). Seventeen *E. coli* strains had both the genes (Table 2). Such higher ESBL positivity in poultry *E. coli* isolates has also been reported from different countries by Maamar et al. (2016), Tekiner and Ozpinar (2016), Casella et al. (2017) and Klimiene et al. (2018). The gene bla_{CTX-M} is the most common and dominant gene among all ESBL genes (Feria et al., 2002; Samanta, 2013). The present study also confirms the earlier reports and identifies it as a potential threat to even human health (Dierikx et al., 2013). The *AmpC* beta-lactamase enzyme is also highly prevalent (87%) among the *E. coli* strains, and the prevalence rate was higher than the observations of Casella et al., 2017 (3.9%) and Van et al., 2008 (23.7%).

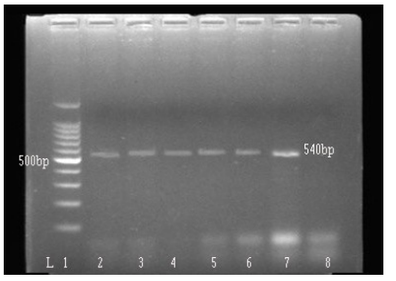

Figure 2: Molecular detection of the bla_{CTX-M} gene (540bp) in *E. coli* isolates by PCR (Lane1: 100bp ladder, L2-6: test samples, L7: positive control, L8: uninoculated negative control)

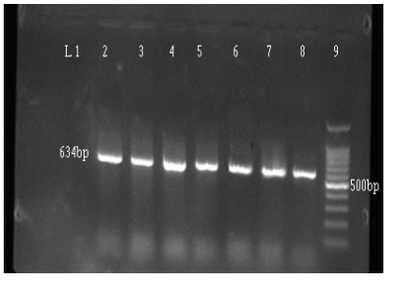

Figure 3: PCR Detection of the bla_{AmpC} gene (634bp) in *E. coli* isolates by PCR (Lane 1: uninoculated negative control, L2: positive control, L3-8: test samples, L9: 100bp ladder).

In-vitro antibiogram of the ESBL-positive *E. coli* isolates revealed high-level resistance (74-100%) to ampicillin,

ceftriaxone, cefotaxime, ceftazidime, ampicillin-clavulanic acid, and norfloxacin (Table 3). In contrast, isolates were sensitive to drugs like amikacin, gentamicin, imipenem, and ampicillin-sulbactam. Such high-level drug resistance by the ESBL-positive *E. coli* isolates was also reported by Van et al. (2008), Reich et al. (2013), Beninati et al. (2015) and Maamar et al. (2016). Again, Tekiner and Ozpınar (2016) reported that *E. coli* from raw chicken meat were resistant to cefotaxime (62.1%), ceftazidime (55.2%), cefoperazone (51.7%) and cloxacillin (20.6%). Van et al. (2008) also reported multidrug resistance among poultry meat *E. coli,* which were resistant to tetracycline (77.8%), ampicillin (50.5%), gentamicin (24.2%) and norfloxacin (17.2%) although few other studies indicated that ESBL positive *E. coli* strains are sensitive to few beta-lactams and aminoglycosides like amikacin, imipenem, ampicillin-sulbactam, and gentamicin (Tekiner and Ozpınar, 2016; Castillo et al., 2018). The rapid increase in the development and spread of antimicrobial resistance (AMR) is a matter of serious concern (Van et al., 2008; Ryu et al., 2012).

Table 2: Detection and distributions of *beta*-lactamases producing genes among *E. coli* isolates from chicken meat in West Bengal

Name of the Districts	No. of meat samples screened	No. of *E. coli* strains Isolated (%)	ESBL positivity in *E. coli* strains (%)	ACBL Positivity in *E. coli* strains (%)	Gene distribution in positive *E. coli* strains		
					$bla_{\text{CTX-M}}$ only	bla_{AmpC} only	$bla_{\text{CTX-M}}$ + bla_{AmpC}
Paschim Medinipur	37	26 (70.27)	6 (23.07)	21 (80.77)	2	18	5
Nadia	46	29 (63.04)	7 (24.14)	23 (79.31)	3	19	6
Hooghly	24	19 (79.17)	5 (26.31)	13 (68.42)	1	11	6
Total	107	74 (69.16)	18 (24.32)	57 (77.03)	6	48	17

Table 3: Resistance pattern of 23 ESBL-positive *E. coli* isolates obtained from chicken meat in West Bengal

Sl. No.	Antimicrobials (Conc. in µg)	Isolates sensitive		Isolates intermediately sensitive		Isolates resistant	
		No.	%	No.	%	No.	%
1.	Amikacin (AK - 30)	19	82.61	4	17.39	0	0
2.	Ampicillin / Clavulanic acid (AMC - 30)	0	0	1	4.35	22	95.65
3.	Ceftriaxone (CTR 30)	0	0	0	0	23	100
4.	Ampicillin/Sulbactam (*A/S* - 10/10 mcg)	18	78.26	5	21.74	0	0
5.	Ampicillin (AM - 10)	0	0	0	0	23	100
6.	Ceftazidime (CAZ - 30)	0	0	1	4.35	22	95.65
7.	Imipenem (IPM - 10)	22	95.65	1	4.35	0	0
8.	Gentamicin (GEN - 10)	20	86.96	3	13.04	0	0
9.	Norfloxacin (NX - 10)	0	0	6	26.09	17	73.91
10.	Cefotaxime (CTX - 30)	0	0	1	4.35	22	95.65

Conclusion:

It can be concluded that approximately 69% of the chicken meat samples screened in this study, were found to be positive for *E. coli* strains. About 31% and 87% of these bacteria were positive for ESBL and ACBL production which are quite significant data. The ESBL-positive stains were resistant to most commonly used antimicrobials other than amikacin, imipenem, gentamicin, and ampicillin/sulbactam. These drug-resistant *Escherichia coli*s train scan become a serious concern for causing animal and human health.

Acknowledgments:

The authors thank the Hon'ble Vice-Chancellor and DREF, WBUAFS for providing necessary funds and the Faculties of the Department of Veterinary Microbiology, WBUAFS, West Bengal for the research facilities and support for this study. The field staff/shop owners also deserve special thanks for their help during sampling.

Conflict of Interest:

No competing interest exists among the authors.

References:

Bauer AW, Kirby WM, Sherrris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. American Journal of Clinical Pathology. 1966; 45(4): 493–6.

Beninati C, Reich F, Muscolino D, Giarratana F, Panebianco A, Klein G, Atanassova V. ESBL-producing Bacteria and MRSA isolated from Poultry and Turkey Products imported from Italy. Czech Journal of Food Science. 2015; 33(2): 97–102.

Carter GR, Wise DJ. Essentials of Veterinary Bacteriology and Mycology. 6th edn., Iowa State Press, 2004. pp. 129-34.

Casella T, Nogueira MCL, Saras E, Haenni M, Madec JY. High prevalence of ESBLs in retail chicken meat despite reduced use of antimicrobials in chicken production, France. International Journal of Food Microbiology. 2017; 257: 271-75.

Castanon JIR. History of the use of antibiotics as growth promoters in European poultry feeds. Poultry Science. 2007; 86: 2466-71.

Castillo RFY, Moreno-Flores AC, Avelar-González FJ, Márquez-Díaz F, Harel J, Guerrero-Barrera AL. An evaluation of multidrug-resistant *Escherichia coli* isolates in urinary tract infections from Aguascalientes, Mexico: cross-sectional study. Annals of Clinical Microbiology and Antimicrobials. 2018; 17: 34-40. (https://doi.org/10.1186/s12941-018-0286-5).

DAHD, A Study of India's Dairy Sector 2017: The World's Largest Producer and Consumer - Research and Markets. https://www.businesswire.com/news/home /20180102005671/ en/Study-Indias-Dairy-Sector-2017-Worlds-Largest. (18/01/23, 8.25 PM IST).

Darwish WS, Eldaly EA, El-Abbasy MT, Ikenaka Y, Nakayama S, Ishizuka M. Antibiotic residues in food: The African scenario. Japanese Journal of Veterinary Research. 2013; 61: S13-S22.

Dierikx C, van Essen-Zandbergen A, Veldman K, Smith H, Mevius D. Increased detection of extended-spectrum beta-lactamase-producing *Salmonella enterica* and *Escherichia coli* isolates from poultry. Veterinary Microbiology. 2010; 145: 273–8.

Dierikx CM, van der Goot JA, Smith HE, Kant A, Mevius DJ. Presence of ESBL/AmpC-producing *Escherichia coli* in the broiler production pyramid: A descriptive study. PLoS One. 2013; 8: 79005.

Feria C, Ferreira E, Correia JD, Goncalves J, Canica M. Patterns and mechanisms of resistance to beta-lactams and beta-lactamase inhibitors in uropathogenic*Escherichia coli* isolated from dogs in Portugal. Journal of Antimicrobial Chemotherapy. 2002; 49: 77-85.

Grami R, Mansour W, Dahmen S, Mehri W, Haenni M, Aouni M, Madec JY. The blaCTX-M-1 IncI1/ST3 plasmid is dominant in chickens and pets in Tunisia. Journal of Antimicrobial Chemotherapy. 2013; 68(12): 2950–2.

Jacoby GA. AmpC-Lactamases. Clinical Microbiology Reviews. 2009; 22(1): 161–82.

Klimiene I, Virgailis M, Kerziene S, Siugzdiniene R, Mockeliunas R, Ruzauskas M. Evaluation of genotypical antimicrobial resistance in ESBL producing *Escherichia coli* phylogenetic groups isolated from retail poultry meat. Journal of Food Safety.2018; 38: e12370 (https://doi. org/10. 1111/jfs.12370).

Maamar E, Hammami S, Alonso CA, Dakhli N, Abbassi MS, Ferjani S, Hamzaoui Z, Saidani M, Torres C, Boubaker IB. High prevalence of extended-spectrum and plasmidic AmpC beta-lactamase-producing *Escherichia coli* from poultry in Tunisia. International Journal of Food Microbiology. 2016; 231: 69 –75.

Maciuca IE, Williams NJ, Tuchilus C, Dorneanu O, Guguianu E, Carp-Carare C, Rimbu C, Timofte D.

High prevalence of *Escherichia coli*-producing CTX-M-15 extended-spectrum beta-lactamases in poultry and human clinical isolates in Romania. Microbial Drug Resistance.2015; 21(6): 651–62. (doi: 10.1089/mdr.2014.0248. Epub 2015 Mar 3).

Nandanwar N, Janssen T, Kuhl M, Ahmed N, Ewers C, Wieler LH. Extraintestinal pathogenic *Escherichia coli* (ExPEC) of human and avian origin belonging to sequence type complex 95 (STC95) portray indistinguishable virulence features. International Journal of Medical Microbiology. 2014; 304 (7): 835–42.

Olesen I, Hasman H, Aarestrup FM. Prevalence of beta-lactamases among ampicillin-resistant *Escherichia coli* and *Salmonella* isolated from food animals in Denmark. Microbial Drug Resistance.2004; 10: 334–40.

Patel JB, Cockerill FR, Bradford PA, Eliopoulos GM, Hindler JA, Jenkins SG, Lewis JS, Limbago B, Miller LA, Nicolau DP, Powell M, Swenson JM, Traczewski MM, Turnidge JD, Weinstein MP, Zimmer BL. Clinical and Laboratory Standard Institute: Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Fifth informational supplement. CLSI document M_{100}-S_{25}. CLSI, Wayne, Pa, USA. 2015; 35(3): 1-240.

Quinn PJ, Markey BK, Leonard FC, Fitz Patrick ES, Fanning S, Hartigan PJ. Veterinary Microbiology and Microbial Diseases, 2nd edn, Blackwell Publishing Ltd. 2011, pp. 266-73.

Reich F, Atanassova V, Klein G. Extended-spectrum β-lactamase– and AmpC-producing enterobacteria in healthy broiler chickens, Germany. Emerging Infectious Diseases. 2013; 19: 1253-9.

Ryu SH, Lee JH, Park SH, Song MO, Park SH, Jung HW, Park GY, Choi SM, Kim MS, Chae YZ, Park SG, Lee YK. Antimicrobial resistance profiles among *Escherichia coli* strains isolated from commercial and cooked foods. International Journal of Food Microbiology. 2012; 159: 263–6.

Sahoo KC, Tamhankar AJ, Johansson E, Lundborg CS. Antibiotic use, resistance development, and environmental factors: A qualitative study among healthcare professionals in Orissa, India. BMC Public Health. 2010; 10: 629-32.

Samanta I. Chapter 6: Enterobacteriaceae, In Veterinary Bacteriology. New India Publishing Agency, New Delhi – 110088. 2013; pp. 119-35.

Tan TY, Yong Ng LS, He J, Koh TH, Hsu LY. Evaluation of Screening Methods to detect Plasmid-mediated AmpC in *Escherichia coli*, *Klebsiellapneumoniae,* and *Proteus mirabilis*. Antimicrobial Agents and Chemotherapy. 2009; 53(1): 146–9.

Tekiner IH, Ozpınar H. Occurrence and characteristics of extended-spectrum beta-lactamases-producing *Enterobacteriaceae* from foods of animal origin. Brazilian Journal of Microbiology. 2016; 47: 444–51.

Tenover FC, Mohammed MJ, Gorton TS, Dembek ZF. Detection and reporting of organisms producing extended spectrum-beta-lactamases: survey of laboratories in Connecticut. Journal of Clinical Microbiology. 1999; 37: 4065–70.

Van TTH, Chin J, Chapman T, Tran LT, Coloe PJ. Safety of raw meat and shellfish in Vietnam: An analysis of *Escherichia coli* isolations for antibiotic resistance and virulence genes. International Journal of Food Microbiology. 2008; 124: 217–23.

Wang R, Cao W, Cerniglia C. PCR Detection and Quantitation of Predominant Anaerobic Bacteria in Human and Animal Fecal Samples. Applied and Environmental Microbiology.1996; 62(4): 1242–47.

Weill F, Claude J, Demartin M, Coignard S, Grimont P. Characterization of ESBL (CTX-M-15) producing strains of *Salmonella enterica* Isolated in France and Senegal. FEMS Microbiology Letters.2004; 238(2): 353-8.

***Corresponding author's email ID:** drkb.micro@gmail.com

Citation: Mondal T, Dey S , Samanta I, Joardar SN, Paul A, Alam SS, Batabyal K. Characterization of Extended-spectrum and p AmpC Beta-lactamases producing *Escherichia coli* from Chicken Meat in West Bengal. Indian Journal of Veterinary Public Health. 2023; 9(2): 27-32. DOI: https://doi.org/10.62418/ijvph.9.2.2023.27-32