sulfonamides, polypeptides, nitrofuran and combinations.

The antibiotic susceptibility pattern indicated that 15.92% of the *Salmonella* isolates were multi-drug resistant (Fig. 1 and 2). Fortysix, 45, 26, 8, and 6% of the isolates showed resistance towards imipenem, nitrofurantoin, cefpodoxime, ceftriaxone and augmentin, respectively. A total of 1.27% of the isolates showed resistance towards ceftazidime, aztreonam, nalidixic acid and

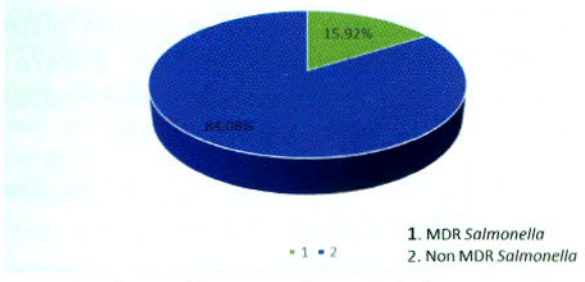

Fig. 1. Prevalence of multi-drug resistant *Salmonella* in seafood

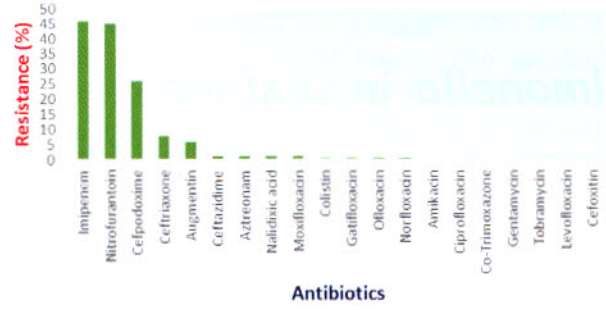

Fig. 2. Resistance pattern of *Salmonella* isolates

moxifloxacin, while only 0.63% of the isolates showed resistance towards colistin, gatifloxacin, ofloxacin and norfloxacin. One hundred percentage of the isolates studied were susceptible towards amikacin, ciprofloxacin, co-trimoxazole, gentamycin, tobramycin, levofloxacin and cefoxitin. Among the multi-drug resistant isolates 87.5% showed resistance towards three antibiotics *viz.*, imipenem (Carbapenem class), nitrofurantoin (Nitrofuran class) and cefpodoxime (3rd generation Cephalosporin class). A total of 4.25% of the MDR isolates showed resistance to more than five classes of antibiotics studied.

The results of this study revealed higher incidence of multi-drug resistance in *Salmonella* towards the frequently used classes of antibiotics in human medicine. In this study, maximum resistance (46%) was shown for imipenem (Carbapenem class) which is generally considered as the last choice of medicine for infections caused by gram negative bacilli. Hence, judicious use of antibiotics in human and veterinary medicine is mandatory and inevitable to avoid MDR *Salmonella*.

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Antibiotic resistance to third generation cephalosporins of *Escherichia coli* isolated from seafood

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Occurrence of pathogenic *Escherichia coli* in seafood is directly related to faecal contamination and through infected handlers during pre and post harvest stages. Frequent use of large number of antibiotics in human therapies, farm animals and aquaculture led to increase the incidence of antimicrobial resistant bacterial strains (Sapkota *et al.*, 2008 and Cheong *et al.*, 2014). Third

generation cephalosporins are broad-spectrum drugs with high intrinsic activity against gram negative bacteria. A widespread and indiscriminate use of antibiotics coupled with the transmissibility of resistance could lead to the emergence of antibiotic resistant *E. coli* (Kang *et al.*, 2005). Several studies demonstrated the prevalence of resistance in Enterobacteriaceae in food products such as meat, chicken, raw milk, fish and environment. Increasing resistance to these newer antimicrobial drugs is a cause of concern because it could be a proxy for the emergence and spread of Enterobacteriaceae strains producing Extended-Spectrum Beta-Lactamase (ESBL) and posing an emerging threat to public health. Recently, several studies have shown infiltration of resistance genes into food chain *via.* direct contact with humans and animals (Egea *et al.*, 2012). Under these circumstances, a preliminary study was carried out to monitor the prevalence of third generation cephalosporin resistant *E. coli* in seafood.

A total of 238 seafood samples were collected from fish market and fish processing industries of Veraval region, Gujarat during 2012 to 2016 and were screened. *E. coli* isolates were identified as per Surendran *et al.* (2013). Four numbers of 3rd generation cephalosporins (HiMedia, Mumbai) were tested by the disk diffusion method on Mueller-Hinton agar with 0.1mL of *E. coli* equivalent to 0.5 McFarland standards in accordance with CLSI guidelines (CLSI, 2014) of antimicrobial concentration: Ceftazidime (CAZ) 30 µg, Ceftizoxime (CZX) 30 µg, Cefotaxime (CTX) 30 µg and Ceftriaxone (CTR) 30 µg and incubated for 18-24 hrs at 37 °C. The results were interpreted employing standard methods (CLSI, 2014) wherein the radial zone of inhibition of growth were expressed as 'sensitive or 'resistant'.

The preliminary epidemiological study was carried out to assess the *in vitro* antimicrobial resistance to four commercially available third generation cephalosporin antibiotics *viz.*, CAZ, CZX, CTX and CTR in *E. coli* isolates from seafood. *E. coli* counts ranged from 2 x 10^1 to 2 x 10^2 cfu.g^{-1} which clearly indicates the possibility of faecal or sewage source as contaminant. Twenty eight samples were found positive with incidence rate of 11.76%. Antimicrobial resistance pattern of *E. coli* strains to third generation cephalosporins are given in Table 1 and 2. Overall higher rate of resistance to third generation cephalosporins ranged from 7.14% to 17.86% with 2 to 5 number of isolates from these seafood samples. The higher rates of resistance to third generation cephalosporins was 14.29%, 10.71% and 10.71% with CAZ, CTX and CTR and the least was found with ceftizoxime (7.14%), respectively. The intermediate resistance was found to CAZ and CZX with 3.57% and CTX and CTR with 7.14%, respectively among these *E. coli* strains. Whereas, two *E. coli* isolates consistently showed resistance patterns with either two or three or with all the third generation antimicrobial combinations and were isolated from Ribbonfish samples. The overall result of the present study shows that the presence of third generation cephalosporin resistant *E. coli* strains in Gujarat is currently not very high. However, if not checked in right time it may shoot up and cause a very serious public health problem among the seafood consumers. The constant use of third generation cephalosporins in the treatment of infections in developing countries like India, is probably the reason for these

Table 1. Percentage of antibiotic resistance of *E. coli* strains to third generation cephalosporins

Name of the antibiotics	No. of resistant strains	% of resistant strains	No. of inter-mediate strains	% of inter-mediate strains	No. of susceptible strains	% of susceptible strains
Ceftazidime (CAZ)	4	14.29	1	3.57	23	82.14
Ceftizoxime (CZX)	2	7.14	1	3.57	25	89.29
Cefotaxime (CTX)	3	10.71	2	7.14	23	82.14
Ceftriaxone (CTR)	3	10.71	2	7.14	23	82.14

Table 2. Antimicrobial resistance patterns of *E. coli* isolates to third generation cephalosporins

Resistant type	No. of resistant strains
CAZ	4
CZX	2
CTX	3
CTR	3
CPM	5
CAZ - CTR	3
CAZ- CTX	3
CAZ- CZX	2
CTR- CTX	3
CTR- CZX	2
CTX- CZX	2
CAZ - CTR- CTX	3
CAZ- CTX- CZX	2
CTR- CTX-CZX	2
CAZ - CTR- CTX- CZX	2
CAZ - CTR- CTX- CZX- CPM	2

incidence and the spread of highly resistant *E. coli* strains. It is further suggested that the strict hygienic practices such Hazard Analysis Critical Control Point (HACCP), Good Hygienic Practices (GHP) and Good Manufacturing Practices (GMP) are to be followed during the entire chain of seafood processing in order to produce wholesome seafood.

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Fishermen preferences towards gear-based fish conservation technologies in Sindhudurg district, Maharashtra

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Sindhudurg district, located at the southern tip of Maharashtra is endowed with a coastline of 121 kilometers. There are 526 mechanized vessels in the district, engaged in fishing operations (ICAR-CMFRI, 2010) and total trawlers operating are 317. In order to reduce the negative impact of trawling