Indian Journal of Agriculture Business
Volume 5 Number 1, January - june 2019
DOI: http://dx.doi.org/10.21088/ijab.2454.7964.5119.2

Original Article

Antibiotic Resistance from Indian Cuisine: A Matter of Well being and Health

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How to cite this article:

S.K. Bharti, Parveez Ahmad Para, Moloya Gogai *et al.* Antibiotic Resistance from Indian Cuisine: A Matter of Well being and Health. Indian Journal of Agriculture Business. 2019;5(1):15-19.

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Received on 01.05.2019
Accepted on 08.06.2019

Abstract

Antibiotics are a major contraption exploited by the health care industry to curb bacterial infections. Consequently, unscrupulous practice of antibiotic plays a considerable role in emerging public health threat of broad concern to countries and multiple sectors crisis of antibiotic resistance. The concern becomes more considerable on future perspective as the global exploitation of antimicrobials for food animal production. Antibiotic residues from food have a dual concern; one is the potential threat of development of toxicity to humans and second is possible expansion of resistant strains and failure of antibiotic therapy in clinical cases. Even upon such perilous effect, the indiscriminate use of antibiotics indicates that antibiotic resistance is still a marginally concern question in India, where the use of antibiotics in agriculture is extensive.

Keywords: Antibiotic resistance; Food; RTE; Meat; Milk.

Introduction

For more than 60 years, antibiotics have been regarded as the panacea to treat microbial diseases. Since then, the greatest threat to the use of antimicrobial agents for therapy of bacterial infections has been the development of antimicrobial resistance in pathogenic bacteria. Among increased alarming emergence in developing countries like India, World Health Organization has acknowledged this contention as one of the most imperative health issues of the 21st century (Cohen & Denning 2017). In India, pervasiveness of high infectious disease in human as well as in animals, easy accessibility of antimicrobial proprietary over the counter and the indiscriminate use of antimicrobial agents are the recognized reason for antimicrobial resistance (Kumar, 2016). The limited references available indicate that antibiotic

resistance is a major predicament in India, and the use of antibiotics in agriculture and livestock sector is widespread. The food chain can be contemplated as the primary route of transmission of antibiotic resistant organism between the agriculture (plant and livestock) and human. The egress of the hazard is also very significant as the drug resistant microbes can easily move from the farm to fork and from one person to the next and further enhanced by increasing cross border movement of human, animals and foodstuffs. The solemn nature of the resistance to such antibiotics has become one of the burgeoning concerns to global public health.

The generations of antibiotics used in agriculture (plant and livestock) especially in food-producing animals and in human are usually same, thereby growing the probability of emergence and proliferation of resistant towards certain class of bacteria. Agricultural livestock and Food-producing animals endure compelling reservoirs of such pathogens which are having huge potential to transfer resistance to human population. In case of aquaculture, antibiotic doses can be proportionately higher in comparison to livestock. The foremost reason of this elevated residue is the use of antibiotics in fish feed, which remain in the aquatic environment for an extensive period of time, providing an additional effect along with the residues remain in the fish products.

Some studies approximated that the quantity of antibiotics used for crops is relatively low in comparison to the quantities used in livestock. The estimate of antibiotic used ranging from 0.2 to 0.4% of total agricultural antibiotic utilization (Smalla and Tiedje 2014). The increased use of fungicides in humans alongside with agriculture has intended the severity of the resistance globally.

Further advanced study and data's are required on the antibiotics need, use and consumption in agriculture, food and treatment sector so as to make polices nationally and globally in order to condense the incidence of antimicrobial resistance. There is further need by farming industry and regulatory bodies to examine the pattern of antibiotic consumption in order to identify priority areas for intervention where these hazards can be prevented or eliminated. Several food sources are recognized as the vigor for antibiotic resistance, such as

Antimicrobial resistance from ready to eat processed foods

Processed foods can be contaminated with antimicrobial resistance pathogens or antimicrobial resistance genes in three broad ways:

1. Antibiotics usage during primary stages of production

a. Antibiotics use in agricultural farm

Antibiotics used during initial agricultural production may lead to contamination of plant products with these resistant organisms. These antimicrobial resistant bacteria can be present in soil, water, human or animal fecal material results in presence of such resistant bacteria in the final produce.

b. Antibiotic use in conventional livestock production

According to study of Van *et al.* (2015) India be the fourth amongst top five most countries in terms of antimicrobial use in livestock production. Laxminaraya and Chaudhury (2016) shown antimicrobial residues in food animal products (such as chicken meat and milk) from various regions of India. In addition to meat and milk, Harsha *et al.* (2011) reported antibiotic-resistant bacteria from eggs, fish, and seafood as well. The similar studies indicating that antibiotic use in food animal production is arbitrary and widespread India.

2. Intentional assimilation during food processing

Microorganisms used during production of fermented foodstuffs may contain antimicrobial resistance genes and can transfer them to the pathogenic bacteria. Microbes used in starter culture for yogurt, fermented sausages, curds, probiotics (yoghurt, health foods, and beverages), bacteriophages (soft cheese, fish/chicken products etc.) or biopreserving microorganisms (fermented foods, boiled meat products etc) are the most important products which can transmit these genes during processing intentionally.

3. Cross-contamination during food processing

Transfer of antimicrobial resistant bacteria or their genes may occur at any stage during processing of the processed food products. During food preparation, pathogenic organisms maybe transferred to food items by the handler both directly or by cross contamination through hands, surfaces, utensils and equipments that have been inadequately clean and disinfected between the preparations of different types of foods. Microbial

contamination is further reported in drains, mats, coolers, air fillers, wall, cleaning utensils and other environments that are wet, cold and difficult to clean, where microbes can survive for long periods due to their ability to form biofilms and resist to bactericidal agents that causes bacterium stresses**.**

Prevalence and Antibiotic Resistance in processed foods

Milk and Milk Products

Contamination of milk and dairy products by pathogenic micro-organisms can be of endogenous origin, following excretion from the udder of an infected animal and /or exogenous origin, through direct contact with infected herds or through the environment. Microorganisms can be transmitted to humans through contaminated and untreated milk and milk products. Milking operations, including storage, handling and transportation are considered as critical points that contaminate milk products. *Staphylococcus aureus* present on the skin and mucosa of food producing animal reservoirs is frequently associated with sub-clinical or clinical mastitis leading to the contamination of dairy products. Chauhan *et al.* (2015) studied the prevalence and antimicrobial resistance of *Staphylococcus aureus* isolated from raw milk (cow and sheep) and dairy products. Tambekar *et al.* (2011) found that, ice creams in Amaravathi, Maharashtra, were contaminated with *Salmonella* sps and *E.coli*. Kalsoom *et al.* (2009) studied the prevalence of food borne pathogens in milk products, khoya and burfi. *Staphylococcus aureus, Escherichia coli* and *Klebsiella* spp., was found prevalently in a bulk number of khoya and burfi samples throughout. *S. aureus* expressed the major part of any bacterial flora present over burfi and khoya samples. Certain spp. Like *Enterobacter* and *E. coli* represented approximately 1.2%, in both burfi and khoya samples. *Klebsiella* spp., *Enterobacter* spp., and *E. coli* were found to be resistant to Urixin.

Meat and Meat Products

Isolation of *Staphylococci* species from meat demonstrated that they have entered the food chain to affect the food safety and public health. Antibiotic-resistant *Salmonella*, *Campylobacter*, *E. coli* and multidrug-resistant *Staphylococcus* have been detected in many different types of retail meat and poultry products. Saravanan *et al.* (2015) found that 21 of 1215 samples collected at 154 different farms in Southern India were positive for non-typhoidal *Salmonella*. Sixteen were classified as *S. typhimurium* and 5 as *S. enteritidis*, both strains highly associated with human disease whereas every isolate were found resistant to oxytetracycline, which is a custom feed additive in poultry industry. Another survey of backyard layers in West Bengal isolated *Salmonella* in cloacal swabs, feed samples, drinking water samples, and eggs. The isolated isolates were found resistant to norfloxacin, chloramphenicol, gentamicin, levofloxacin, oxytetracycline and ciprofloxacin, (Samanta *et al.,* 2014). A similar study of Hemlata *et al.* (2015) instituted that 96% of chicken samples collected from local meat shops of Bikaner containing *S. aureus.*

Sea foods

The faecal contamination of natural water bodies has emerged as a major challenge in developing and densely populated countries. Antibiotic-resistant pathogens have tremendously reported from seafood products obtained from India as well. For example, the trimethoprimsulfamethoxazole (SXT) resistance of fish pathogen aeromonads isolated from seafood products in Germany (Kadlec *et al.,* 2011). Done *et al.* (2015) reported level of resistance consistently increasing in all food animals including aquaculture. Kumar *et al.* (2016) investigated the occurrence of methicillin-resistant staphylococci in fresh seafood, seafood products and related samples. Deekshit *et al.* (2012) tested *Salmonella* isolates from fish and shellfish from markets and fish landing centres in Mangalore for nine antibiotics in which two-third were found resistant to at least two antibiotics, and a quarter of the isolates were found resistant to three or more drugs taken in the study.

Ready-to-Eat and Restaurant foods

Ready-to-eat foods include processed dairy, meat, seafood and vegetable products and restaurant foods are usually ingested directly without further thermal processing. Therefore, they could be a vehicle for the spread of Antibiotic–Resistant Microorganisms. The ready-to-eat foods are usually kept at room temperature which causes germination and multiplication of *B. cereus* (Sandra et al., 2012). The same problem may occur when foods such as pasta and pizza are stored for long periods of time at room temperature (Tiwari and Abdullah, 2015). The microbiota of RTE foods are affected by the microorganisms associated with raw materials, as well as by post harvest processing, handling and storage procedures

before consumption (Khairuzzaman *et al.,* 2014). Meat samples (mutton tikka and chutney samples) collected from Kashmir valley, showed 45 % prevalence of B. cereus in mutton tikka and 32.5 % in the chutney samples (Hafiz *et al.,* 2012) and 16%in the raw milk (Altaf *et al.,* 2012).

Street vended foods

The hygiene aspects of vending operations are a poorly maintained in India, like stands are often crude structures, running water, washing facilities, are inadequately available. Washing of hands, utensils and dishes often is done in buckets or bowls. Unorganised waste disposal and improper disinfection attracts insects and rodents around. Moreover, food is not well protected from flies and refrigeration is not available (Cuprasitrut *et al.,* 2011). *Salmonella sp., Shigella sp., Listeria sp.* and other food borne pathogens were identified in street foods in different studies carried out in India (Sharma and Mazumdar, 2014).

Impact of food borne antimicrobial resistance on well being and health of consumers

It has been reported that 700,000 children in one WHOregioninSoutheastAsiadieofunsafefoodyearly. Antimicrobial resistance is one of the main threats to modern medicine. Firstly there is the immediate risk that medical treatment may fail. Secondly, the choice of antibiotics for treatment is limited and third is that the resistant GI pathogens may acquire even more resistance when treated with antibiotics for other medical reasons. Thereafter, the chances of higher risk also exist in that of increased virulence which maybe due to a co-selection of resistance and virulence properties through integration of virulence and resistance plasmids. Hence the need of the moment at present is to implement effective and efficient intervention programs that could help reduce burden of FBDs. Such intervention should include food safety education and awareness, good food handlers' hygiene and national FBD occurrence surveillance and monitoring programs. Similarly, a comprehensive systematic review of occurrence and prevalence of FBDs and antibiotic resistance in developing countries needs to be carried out as adequate information is lacking, thereby making it difficult to take proactive intervention steps toward prevention of these diseases. There is also need for research scientists in developing countries to investigate occurrence of FBDs in each country and also across borders.

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