



Consumers' knowledge regarding antibiotic residues and their consciousness about food safety issues in livestock products

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ABSTRACT

Intensification of the animal husbandry sector in India is overlapping with the increased administration of antibiotics in food-producing animals for therapeutic, prophylactic and growth promotion purposes. Now antibiotic residues are appearing in milk, meat, and eggs if the withdrawal period is not observed, leading to adverse effects on human health due to its consumption. Thus there is need to study the consciousness of consumers about food safety issues and their knowledge about antibiotic residues in livestock products. The present study has been conducted purposively in Telangana state by selecting 120 non-vegetarian consumers. The study revealed that respondents from the study area, preferred taste, followed by price over the other attributes while purchasing the livestock products. Antibiotic residues and hormone residues were the least considered attributes revealed by respondents. About 71% had low level of knowledge followed by medium about antibiotic residues in livestock products and antimicrobial resistance. Lack of concern and knowledge suggest low level of consumer awareness as well as consciousness about the potential risks associated with these residues on human health. Thus, there is need to provide adequate information and education amongst the general public about these emerging food safety issues.

Keywords: Antibiotic residues, Awareness, Consciousness, Egg, Knowledge, Livestock products, Meat, Milk

Livestock industry is also rapidly intensifying along with increasing administration of antimicrobial agents in food-producing animals to prevent diseases and achieving the fastest growth in a short period (Manna *et al.* 2006). Global consumption of antimicrobials in food animal production has been estimated at 63,151 ($\pm 1,560$) tonnes in 2010 and is projected to rise by 67%, to 105,596 ($\pm 3,605$) tonnes, by 2030. Two-thirds of the global increase in antimicrobial consumption is due to the growing number of animals raised for food production. India accounts for 3% of global consumption and is at fourth place among the top five consumers worldwide, along with China, the United States, Brazil, and Germany (Van Boeckel *et al.* 2015). Commonly used antibiotics and veterinary drugs in food-producing animals have the potential to generate residues in animal-derived products like milk, meat, and eggs if failure to observe withdrawal period and poses a health hazard to the consumer (Prajwal *et al.* 2017). The literature on the demand for food suggests that consumer perception of quality, safety,

and convenience may influence the price and purchase of livestock products (Grunert 2005).

This study primarily focuses on consumer knowledge regarding antibiotic residues. Thus assessment of consumer preferences both in rural and urban areas for quality attributes while purchasing milk, meat, eggs and their consciousness about food quality and safety issues not only provide a database but also will further help to create public awareness regarding safe, and healthy food consumption.

Kumar (2010) reported that out of 200 milk samples, 105 (53%) samples showed the presence of tetracycline's and 137 (69%) sulfonamides residues and among positive samples, some of the samples had concentration above the maximum residue limit (MRL) value. Overall 13.63% incidence of antibiotics residues found in raw milk samples from Delhi and villages near Delhi (NDRI, 2010–11). Gaurav (2014) reported that out of 356 milk samples, 46 (12.9%) and 33 (9.2%) samples were found positive for enrofloxacin and ciprofloxacin residues in Punjab. In Mumbai, cent percent antibiotic residue prevalence was found in 4 different market egg samples and in one farm, it was up to 60% (Madhavaprasad 2009). In Chennai, 30.56% of the poultry (meat, liver, kidney, muscle) samples found detectable levels of enrofloxacin residues at the time of marketing (Suresh Kumar 2012). In a latest study, 22.9% of chicken samples were found positive for at least one

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antibiotic residue and 17.1% samples had residues more than one antibiotic in Delhi (Sahu and Saxena 2014).

MATERIALS AND METHODS

The present study was carried out purposively in the Telangana state because it has the highest proportion of meat-eaters in India with almost 99% of its residents being non-vegetarians (Sample Registration System Baseline Survey 2014, GoI). Sixty non-vegetarian consumers from rural areas covering three districts (Karimnagar, Medak and Mahabubnagar) and 60 more from urban area (Hyderabad city) were interviewed through convenience sampling. Structured interview schedule was used to collect data from 120 consumers on their preferences for quality attributes while purchasing the livestock products, their awareness and consciousness about food quality and food safety issues and knowledge about antibiotic residues and antimicrobial resistance in livestock products on three-point continuum, i.e always, sometimes and never with respective scores of 3, 2 and 1 and were ranked based on their total score. Data on knowledge level was collected through a set of 12 yes/no type of questions. The interview schedule was validated by doing pre-test in the non-sample area before the actual data collection. Necessary modification in the interview schedule was carried out based on the pre-test feedback and advice of subject experts. Collected data were analyzed on SPSS version 25. Total weighted score and total mean score methods were used to prioritize different attributes and their awareness and consciousness about food quality and safety issues.

RESULTS AND DISCUSSION

Preferences for quality attributes while purchasing livestock products revealed by rural and urban consumers: Data on consumers preferences were collected on 12 different quality attributes usually considered while

purchasing the livestock products. Table 1 revealed that irrespective of locale, respondents preferred for taste over the other attributes while purchasing the milk, meat, and eggs. Price was the second and discount as third preferred attribute considered by rural respondents as compared to urban, who preferred manufacturing/expiry date as second followed by the price of the product. Respondents least considered attributes such as chemical/pesticide residues, antibiotic residues, and hormone residues in the livestock based products. Differences in the considerations of the attributes between urban and rural consumers may be due to education, living style, purchasing power, and availability of more quality products in the local markets.

Jabbar and Admassu (2010) reported that hygiene and smell followed by fat content, adulteration and price as the most important quality and safety criteria for Ethiopia consumers. Antibiotic residues in meat were not preferred attribute among Kenyan consumers due to low awareness and mostly rely on visual product attributes (Fadiga 2009). Muhammad *et al.* (2010) found that in the United Arab Emirates Urdu/Hindi-speaking consumers noticed price first but English and Arab consumers looked for expiry dates first.

Awareness and consciousness among consumers about food quality and safety issues: Data were collected on 8 food quality and safety attributes from rural and urban consumers while ascertaining the quality of livestock products during purchase. Irrespective of locale, consumers were more aware and conscious for appearance, colour, texture, and odour under the sensory attributes followed by adulteration. Respondents were least aware and conscious about zoonotic diseases, antibiotic residues and antimicrobial resistance as food safety issues while ascertaining the quality of animal-based products. Lapar *et al.* (2010) also supported the findings and reported that consumers were more depended on visual inspection

Table 1. Consumer preferences for quality attributes while purchasing milk, meat and eggs

Attribute	Consumers								
	Rural (n=60)			Urban (n=60)			Total (N=120)		
	TWS	TMS	Rank	TWS	TMS	Rank	TWS	TMS	Rank
Brand	72	1.20	XI	107	1.78	X	179	1.49	X
Manufacturing /expiry date	135	2.25	V	163	2.72	II	298	2.48	II
Taste	169	2.82	I	168	2.80	I	337	2.81	I
Discount	143	2.38	III	131	2.18	VII	274	2.28	VI
Organic/ Non-organic	74	1.23	X	85	1.42	XI	159	1.33	XI
Packaging	106	1.77	IX	135	2.25	VI	241	2.01	IX
Hygiene	128	2.13	VII	138	2.30	V	266	2.22	VII
Price	148	2.47	II	130	2.17	III	278	2.32	IV
Nutritive value	133	2.22	VI	144	2.40	IV	277	2.31	V
Fat content	122	2.03	VIII	129	2.15	IX	251	2.09	VIII
Pathogen free	138	2.30	IV	147	2.45	III	285	2.38	III
Chemical/ pesticide residues	63	1.05	XII	68	1.13	XII	131	1.09	XII
Antibiotic residues	62	1.03	XIII	64	1.07	XIII	126	1.05	XIII
Hormone residues	61	1.02	XIV	64	1.07	XIII	125	1.04	XIV

TWS, total weighted score; TMS, total means score.

Table 2. Awareness and consciousness among urban and rural respondents about the food quality and safety issues

Food quality and safety issues	Consumer								
	Rural (n=60)			Urban (n=60)			Total (N=120)		
	TWS	TMS	Rank	TWS	TMS	Rank	TWS	TMS	Rank
Sensory attributes (appearance, colour, texture and odour)	165	2.75	I	160	2.67	I	325	2.71	I
Antibiotic residues	66	1.10	VII	67	1.12	VII	133	1.11	VII
Chemical and pesticide residues	82	1.37	IV	80	1.33	V	162	1.35	V
Antibiotic resistance	62	1.03	VIII	66	1.10	VIII	128	1.07	VIII
Adulteration	88	1.47	II	102	1.70	II	190	1.58	II
Additives in food	78	1.30	V	96	1.60	III	174	1.45	IV
Food borne diseases	84	1.40	III	95	1.58	IV	179	1.49	III
Zoonotic diseases	70	1.17	VI	77	1.28	VI	147	1.23	VI

TWS, total weighted score; TMS, total means score.

to ascertain the quality of raw milk in Assam. Cambodia consumers were also not much concern about residual substances such as hormones, antibiotics and growth promoters in pork meat (Borin *et al.* 2010). However, residues in meat products as an important safety concerned for 50% of Tunisian consumers revealed by Zaibet and Mtimet in 2010.

Willingness to pay by the consumers for the purchase of quality livestock products: An attempt was made to understand consumers' willingness to pay for quality milk, meat, and eggs. Surprisingly only 20% rural and about 37% urban consumers were ready to pay and rest did not show interest. Those who were ready to pay were asked to mention the extra amount they could pay for quality livestock products. About 58% rural consumers were ready to pay 5% over and above the normal price, whereas 50% of urban consumers were ready to pay even 10% more prices for guaranteed quality and safe animal-based products. Significant difference ($p < 0.05$) was found between rural and urban consumers regarding their willingness to pay for the purchase of quality livestock products (Table 3). Similar results were found by Makokha and Fadiga (2009) wherein they mentioned 63% of consumers in Kenya expressed their

willingness to pay more for improved quality meat. Amongst urban consumers, 63% were willing to pay 10% premium over the normal price against 74% of rural respondents in Cambodia (Borin *et al.* 2010). In India, 65% of urban dwellers against 32% of their rural counterparts in Assam were ready to pay more guaranteed quality milk (Lapar *et al.* 2010).

Knowledge level of the consumers about antibiotic residues in livestock products and antimicrobial resistance: The knowledge of the consumers was studied with the help of 12 yes/no type of knowledge statements about antibiotic residues in livestock products and antimicrobial resistance. Table 4 shows that 71% of the respondents had low level of knowledge followed by medium and high level. Amongst rural consumers, 80% against 63% of the urban consumers fell under low level of knowledge category. Significant differences ($p < 0.05$) were found between knowledge levels of rural and urban consumers regarding antibiotic residues and antimicrobial resistance and its consequent effects on human and animal health. Lack of awareness and knowledge on the emerging area might be due to less education and professionally educated respondents had not updated their knowledge regarding the effects of antibiotic

Table 3. Willingness to pay among rural and urban respondents for purchase of quality livestock products

	Consumers			χ^2 value
	Rural (n=60)	Urban (n=60)	Total (N=120)	
<i>Willingness to pay for quality livestock products</i>				4.104*
Yes	12 (20.00)	22 (36.7)	34 (28.30)	
No	48 (80.00)	38 (63.3)	86 (71.70)	
<i>Extra amount ready to pay</i>	Rural (n=12)	Urban (n=22)	Total (N=34)	
5% over and above the normal price	7 (58.33)	8 (36.37)	15 (44.12)	
10% over and above the normal price	5 (41.67)	11 (50.00)	16 (47.06)	
>10% over and above the normal price	–	3 (13.63)	3 (8.82)	

Figures in parentheses indicate a percentage, *Significant at 5% level ($p < 0.05$).

Table 4. Knowledge level of respondents on antibiotic residues and antimicrobial resistance and consequent effects on human health

Knowledge level (scores)	Consumers			Z value
	Rural (n=60)	Urban (n=60)	Total (N=120)	
Low (0–4)	48 (80.00)	38 (63.30)	86 (71.70)	11.746*
Medium (5–8)	8 (13.30)	15 (25.00)	23 (19.20)	
High (9–12)	4 (6.70)	7 (11.70)	11 (9.20)	

Figures in parentheses indicate percentage, *Significant at 5% level ($p < 0.05$).

residues in livestock products and antimicrobial resistance in this area.

Desai *et al.* (2018) also reported that public in Davanagere city had low knowledge regarding antimicrobial resistance and recently Kumar *et al.* (2019) found that majority of dairy farmers in Haryana had low level of knowledge on antimicrobial resistance.

This study revealed that consumers relied more on the visual attribute while assessing the quality of milk, meat, and eggs for purchase. They were not much concerned about the presence of residue substances in animal food products. Lack of concern and knowledge suggest low levels of consumer awareness as well as consciousness about the potential risks associated with these residues on human health. Thus, consumers in city as well as in rural areas should be made aware of the risks of consuming products and need to provide adequate public information and education about these emerging food safety issues. Demand of consumers to pay more prices for safe and quality livestock products offers good opportunities to livestock farmers to produce such safe and residue free products to realize better prices.

Awareness and knowledge may be enhanced through organizing awareness campaigns on the effects of AMR on public health through television advertisement or in movie halls before playing the movie, by placing the hoardings in the local language at railway stations, supermarkets, shandies, etc. Development and distribution of the educational material at hospitals, pharmacy shops along with medicines will also help in increasing the awareness among the public. Social media like twitter, facebook can play major role in reaching large number of people in less time. Traditional media may also play a crucial role to create awareness in interior rural areas. Similarly awareness classes to college youth and school children can also be created by coordinating the health and animal husbandry departments in this direction.

This is purely academic study thus had limitations of size and locale of the respondents. Although results of this study cannot be generalized to other cities of India but it highlights the need for educational interventions to increase the alertness about the antibiotic residues to make consumers more cautious and ultimately everyone should

have healthy and safe food.

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REFERENCES

- Borin K, Lapar M L A, Nga N T D, Jabbar M A and Sokerya S. 2010. Consumer demand for fresh and processed pork in Cambodia. *ILRI Research Report 24*. pp. 160–168.
- Desai A J, Gayathri G V and Mehta D S. 2016. Public's perception, knowledge, attitude and behaviour on antibiotic resistance—A survey in Davangere City, India. *Journal of Preventive Medicine and Holistic Health 2*(1): 17–23.
- Fadiga M L, Baker D and Jabbar M A. 2009. Demand for livestock products in developing countries with a focus on quality and safety attributes: Evidence from Asia and Africa. *ILRI Research Report 24*.
- Gaurav A. 2014. 'Studies on antibiotic residues in milk in Punjab and its public health significance'. PhD Thesis (Unpublished). Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, India.
- Grunert K G. 2005. Food quality and safety: Consumers perception and demand. *European Review of Agricultural Economics 32*(3): 369–91.
- Jabbar M A and Admassu S A. 2010. Assessing consumer preferences for quality and safety attributes of food in the absence of official standards: The case of beef, raw milk and local butter in Ethiopia. *ILRI Research Report 24*. pp. 38–58.
- Kumar P. 2010. Studies on antimicrobial residues in milk of cattle and buffaloes. M.V.Sc. Thesis (Unpublished). Birsa Agricultural University, Ranchi, India.
- Kumar V, Gupta J and Bishnoi S. 2019. Revealing magnitude of awareness about antibiotic resistance among dairy farmers in Eastern Haryana region of India. *Indian Journal of Extension Education 55*(1): 16–22.
- Lapar M L A, Choubey M, Patwari P, Kumar A, Baltenweck I, Jabbar M A and Staal S. 2010. Consumer preferences for attributes of raw and powdered milk in Assam, Northeast India. *ILRI Research Report 24*. pp. 103–115.
- Madhavaprasad. 2009. 'A comprehensive study on quality and safety of raw shell eggs from commercial layer farms and different markets'. Ph.D. Thesis (Unpublished). Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, India.
- Makokha S and Fadiga M. 2009. Exploiting markets for dairy and meat products' quality and safety: A Kenyan case study. *ILRI Research Report 24*. pp. 72–92.
- Manna S K, Brahmane M P, Manna C, Batabyal K and Das R. 2006. Occurrence, virulence characteristics and antimicrobial resistance of *Escherichia coli* O157 in slaughtered cattle and diarrhoeic calves in West Bengal, India. *Letters in Applied Microbiology 43*(4): 405–409.
- Muhammad S, Sherif S and Gheblawi M. 2010. Consumers' attitudes and perceptions of food safety in the United Arab Emirates. *Journal of Food Distribution Research 41*(2): 73–85.
- National Dairy Research Institute. 2010–2011. Annual Report.

- NDRI, Karnal, India.
- Prajwal S, Vasudevan V N, Sathu T, Irshad A, Nayankumar S R, and Pame K. 2017. Antibiotic residues in food animals: Causes and health effects. *Pharma Innovation Journal* 6: 1–4.
- Sahu R and Saxena P. 2014. Antibiotics in chicken meat. Centre for Science and Environment, New Delhi.
- Sample registration system baseline survey. 2014. Office of the registrar general and census commissioner, India.
- Suresh Kumar V. 2012. 'Residue profile of enrofloxacin and its primary metabolite ciprofloxacin in broiler chicken'. Ph.D. Thesis (Unpublished). Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India.
- Van Boeckel T P, Brower C, Gilbert M, Grenfell B T, Levin S A, Robinson T P and Laxminarayan R. 2015. Global trends in antimicrobial use in food animals. *Proceedings of the National Academy of Sciences* 112(18): 5649–54.
- Zaibet L and Mtimet N. 2010. Consumer perceptions of the quality and safety of meat from small ruminants: Implications for livestock keepers in Tunisia. ILRI Research Report 24. pp. 59 71.