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Knowledge, Attitudes and Practices of the Farmers towards Antibiotic Usage in Layer Birds in Haryana, India: A Cross-sectional Survey

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The antibiotic usage practices of poultry farmers have drastically changed over decades in most of the developing countries like India. The present study carried out in 100 layer farms of Haryana, India from March, 2022 to November, 2022 to assess the knowledge, attitudes and practices of farmers towards antibiotic usage in layer birds using structured questionnaire. The findings suggested that 39 (39%) farmers had correct knowledge, 67 (67%) farmers had positive attitudes and 64 (64%) farmers followed good practices towards antibiotic usage in layer farms. The statistical analysis revealed farmers owning small size farms had 0.12 times lower odds (p<0.01, OR=0.12, 95% CI=0.03-0.55) of positive attitudes than farmers owning large size farms. Further, the farmers who used self-made feeds at their farms had 5.08 times lower odds (p<0.01, OR=5.08, 95% CI=1.49-17.25) of positive attitudes towards antibiotic usage as compared to commercial feed users. An interesting finding of the survey was that farmers who had education level up to 12th grade showed 5.65 times higher odds (p<0.01, OR=5.65, 95% CI=1.52-20.93) of having better knowledge of antibiotic usage than graduate farmers. A high proportion of farmers even used antibiotics without proper consultation with the veterinarian. Thus, the study suggests that farmers owning small sized farms and using self-made feed had positive attitude towards antibiotic usage. Additionally, farmers who had education up to 12th grade showed better knowledge of antibiotic usage. There is a significant gap between farmer's knowledge and attitudes. Lack of strict legislation, restrictions on antibiotic use and farmer's self-prescription of antibiotics to the flock are highly accountable for the increasing antibiotic resistance and production of residues contaminated eggs which is a major threat to public health globally.

Keywords: Antibiotic resistance; attitudes; knowledge; layer farmers; practices.

1. INTRODUCTION

Antibiotics are significantly employed in poultry flocks for therapeutic purposes, enhancing growth and productivity to meet the increasing demand of meat and eggs. However, their non-prudent use is escalating the problem of antibiotic resistance. India is one of the largest producers of poultry eggs and stands 3rd in egg production in the world [1]. Notably, antibiotics are essential for ensuring animal health by lowering the burden of infectious diseases and reducing mortality. Antibiotics such as tetracyclines, fluoroquinolones, sulphonamides, ionophores, macrolides, aminoglycosides, lincosamides, *etc.* are widely used in poultry for improving growth and feed efficiency in addition to treatment and prophylaxis of the diseases [2,3,4]. One of the most important consequences of the non-prudent use of antibiotics in poultry production is the emergence of antibiotic resistant strains of bacteria [5]. These antibiotic resistant strains of bacteria subsequently escape and spread in the environment mainly through excreta/ droppings which consequently has major effects on humans and all other living species in the environment [6]. Additionally, the paucity of data available on antibiotic usage in layer production in India which is the major driver of increasing antibiotic resistance in human and animal populations [7].

The irrational use of antibiotics, improper hygiene and poor bio-security practices mainly contribute towards the promotion of antibiotic resistant bacteria in the environment [8]. Furthermore, tetracycline group (tetracycline, chlortetracycline, oxytetracycline and doxycycline) of antibiotics are widely used in the layers as growth promoters or for disease control because of their broad spectrum activity and low cost compared with other antibiotics [9,10,11]. The presence of antibiotic residues in eggs is highly influenced by the knowledge, attitudes and practices (KAP) of farmers towards the antibiotic usage in layer birds [12]. The non-prudent use of antibiotics such as self-administration of antibiotics, extra-label use, failure to follow label instructions and non-adherence to withdrawal periods prior to egg laying, may leave residues in eggs at levels that are potentially harmful to human health [13,14,15]. Thus, the sound knowledge of farmers towards judicious use of antibiotics in layer birds is fundamental to prevent the occurrence of residues in eggs and further spread of antibiotic resistant bacteria. The findings of the present study will help in recognizing the gaps and identification of the factors associated with antibiotic usage by the farmers in layer birds in Haryana, India. Also, the present study could contribute towards more focused antibiotic resistance control initiatives in India.

2. MATERIALS AND METHODS

2.1 Study Area and Data Collection

Haryana is a northern Indian state that lies between latitudes 27° 39′N to 30° 35′N and longitudes 74° 28′E to 77° 36′E with an egg production of 66,153 lakhs per annum and stands 6th in egg production in the country [16]. A total of hundred layer-farms from 05 districts of Haryana *viz*., Hisar, Panchkula, Panipat, Karnal and Jind were visited in the present study. Twenty (20) layer farms from each of these 05 districts were selected randomly because these districts are among the top contributors to Haryana's total egg production [17] (Fig. 1). The layer farms were visited for the assessment of KAP of farmers towards antibiotic usage in layer birds using a structured questionnaire. The questionnaire consisted of five sections *viz.,* farm overview, socio-demographic information, knowledge, attitudes and practices towards antibiotic usage. Mostly the valuable information was targeted which could help to identify the gaps. Initially, a pilot study was carried out with five farmers owning layer poultry farms, to evaluate the viability and suitability of the questionnaire designed for the main study. Following the pilot study, needful revisions and refinements were made to the questionnaire for ensuring effective data collection. All the questions pertaining to farmers KAP were close ended which provided holistic approach for better understanding of farmer's perspective towards antibiotic usage. Each respondent was given a unique serial number in order to safeguard their confidentiality. The questionnaire was filled up using information provided by the respondent. Later, the data was entered to a Microsoft Excel spreadsheet (Microsoft Excel 2010, Microsoft Corporation, Redmond, Washington, USA) for further processing and analysis. The data collection process for the survey took place from March 2022 to November 2022, allowing for an extended period of data collection.

2.2 Statistical Analysis

The data was analyzed using SPSS statistical software (version 20.0, IBM Corp., Armonk, NY). Responses in the KAP component were coded as binary variables (0 = "No," 1 = "Yes") for easy distinction between affirmative and negative answers. Categorical socio-demographic data were presented as frequencies and percentages. Descriptive statistics tested the association of socio-demographic factors such as age, training source, occupation and education level. The mean served as a cut-off for KAP scores [18]. Scores equal to or above the mean indicated

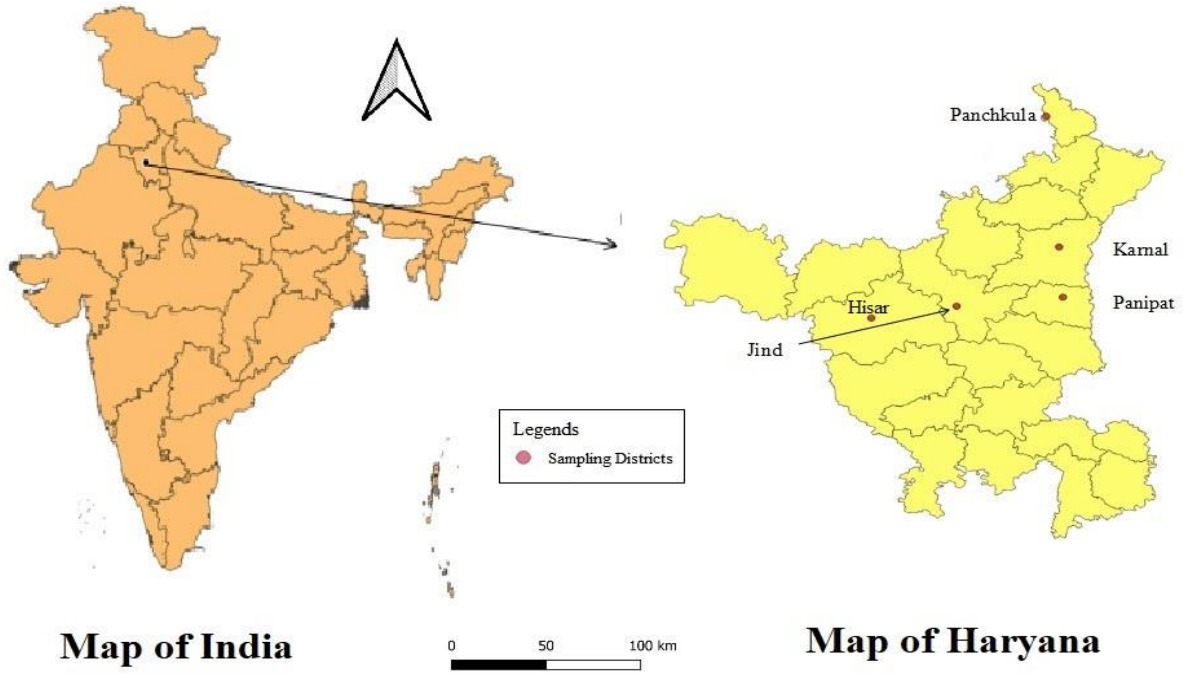

Fig. 1. Geographical area representing the districts of Haryana State from where the responses of layer farmers were recorded

correct knowledge, good practices and positive attitudes toward antibiotic use, while scores below the mean highlighted gaps. The χ2 test and logistic regression were used to analyze factors associated with farmers' KAP on antibiotic usage. The χ2 test identified significant associations, while logistic regression assessed the effects of multiple factors. Pearson correlation examined the relationship between mean KAP scores. A p-value of <0.05 was considered significant and odds ratios (OR) with 95% confidence intervals (CI) were calculated to assess the strength of associations.

3. RESULTS

3.1 Respondent's Socio-Demographic Characteristics

In the present study, personal interviews with 100 layer farmers were conducted and response rate was 100%. Majority of the participants had layer birds, while only few had both layers and breeders on their farms. All the respondents were male and most of them had poultry farming as their main occupation. Out of total, 28% of farmers had experience of more than 50 years in layer farming, all held ancestral training. In terms of education, only 21% of the participants had education level upto 12th grade. The detailed socio-demographic characteristics of the farmers are given in Table 1.

3.2 Respondent's Knowledge, Attitudes and Practices

The results revealed a limited level of knowledge among the participants. Only 39 (39%) farmers responded correctly towards the knowledge-based questions (Table 2). All the farmers knew about the antibiotics (100%). Results showed that the majority of the farmers (88%) did not know about the antibiotic residues and most of the farmers (98%) did not know the withdrawal period of antibiotics. When asked about the reduction in the efficacy of the same antibiotic when used over a period of time only 21% of the farmers had correct knowledge. Nevertheless, 35% of farmers knew that antibiotics are used in the feed of poultry for the prevention of diseases. It was interesting to note that 53% of farmers knew that adoption of biosecurity measures and improved hygiene can reduce the use of antibiotics.

More than half of the farmers (67%) had positive attitudes towards antibiotic usage (Table 3). Results showed that 100% of farmers agreed to reduce the usage of antibiotics if they knew the antibiotics are harmful in some sense. About 81% of farmers admitted that only veterinarians are eligible to prescribe antibiotics for poultry whilst 71% of farmers had opinion that the regular vaccination can reduce the use of antibiotics and adoption of good hygiene practices and vaccination can prevent the occurrence of diseases. The fact that inappropriate use or half course of antibiotics leads to antibiotic resistance was accepted by only 21% of farmers and only 10% of farmers thought that the withdrawal period should be followed before selling the eggs of treated birds.

The mean score of good practices was observed in 64 (64%) farmers on antibiotic usage in layer farms (Table 4). Results reported that about 81% of farmers checked the expiry date of drugs and followed the complete course of antibiotics. About 19% of the farmers had good practices of not disposing off the farm waste near a water body. Moreover, 89% of farmers had attended training to improve their knowledge of antibiotic usage and 100% of the farmers agreed that they follow proper biosecurity measures. Surprisingly, it was observed that 65% of the farmers increase the dose of antibiotics by themselves if the birds don't recover and nearly half of the respondents (49%) used antibiotics in all sheds if some birds in the flock get the infection.

3.3 Data Analysis

Data analysis showed that the odds of using antibiotics increased with farm size. Farmers with small farms had 0.12 times lower odds ($p<0.01$, OR=0.12, 95% CI=0.03-0.55) of having positive attitudes than those with large farms. Farmers using self-made feeds had 5.08 times lower odds ($p<0.01$, OR=5.08, 95% CI=1.49-17.25) of positive attitudes toward antibiotic use compared to commercial feed users. Interestingly, farmers with education up to 12th grade had 5.65 times higher odds ($p<0.01$, OR=5.65, 95% CI=1.52-20.93) of better antibiotic knowledge than graduates (Tables 5 and 6).

The correlation coefficient between knowledge and attitudes was -0.049, indicating a very weak, non-significant negative correlation (p=0.626). Similarly, the knowledge-practices correlation was -0.041 (p=0.685) and attitudes-practices showed a weak positive correlation of 0.05 (p=0.624). Overall, Pearson's test revealed no significant correlation between KAP variables toward antibiotic use (Table 7).

Table 1. Socio-demographic characteristics of the respondents

Variables		N (%)
Type of birds at the farm	Layers	90 (90%)
	Layers + Breeders	10 (10%)
Farm size	Small (≤25000)	25 (25%)
	Medium(25000-50000)	40 (40%)
	Large(≥50000)	35 (35%)
Type of feed used at the farm	Self-made	36 (36%)
	Commercial	64 (64%)
Feeding schedule	Twice	86 (86%)
	Thrice	14 (14%)
Age of the farmer	≤40	31 (31%)
	40-50	41 (41%)
	≥50	28 (28%)
Training of poultry farming	Ancestrol	35 (35%)
	Friends	41 (41%)
	Professional institution trained	17 (17%)
	Others	7 (7%)
Experience in poultry farming	≤10 years	25 (25%)
	10-20 years	46 (46%)
	≥20 years	29 (29%)
Main Occupation	Poultry farming	95 (95%)
	Others	5 (5%)
Level of Education	12^{th} grade	21 (21%)
	Graduate	79 (79%)

Table 2. Knowledge of farmers towards antibiotic usage in layer birds

Knowledge			
Questions (Correct answer)		**Correct response**	**Incorrect response**
1	Do you know about antibiotics? (Yes)	100	0
2	Do you know about antibiotic residues? (Yes)	12	88
3	Do you know about antibiotic resistance? (Yes)	56	44
4	Do you know antibiotics pass in the eggs of treated birds? (Yes)	10	90
5	Do you know about withdrawal period of antibiotics? (Yes)	10	90
6	Do you know frequent use of same antibiotics will decrease their efficacy? (Yes)	21	79
7	Do you know specific antibiotics acts against specific disease? (Yes)	5	95
8	Do you know consumption of antibiotic residue containing eggs causes some side effects in humans? (Yes)	8	92
9	Do you know treatment is needed for whole flock when only some birds are diseased? (No)	11	89
10	Do you know antibiotics are used in feed of poultry for prevention of disease? (No)	35	65
11	Do you know biosecurity and improved hygiene can reduce the use of antibiotics? (Yes)	53	47
12	Do you have any idea that antibiotics are used to cure infections caused by viruses? (No)	0	100
Overall level of knowledge		**Frequency (%)**	
Correct		39 (39%)	
Incorrect		61 (61%)	

Table 3. Attitudes of farmers towards antibiotic usage in layer birds

Attitudes			
Questions (Correct answer)		**Correct response**	**Incorrect response**
1	Do you think antibiotics should be used as growth promoter any time in the feed /water for a prevention of disease? (No)	100	0
2	Do you think poultry deaths can be reduced through antibiotics usage? (Yes)	31	69
3	Do you think it is possible to reduce antibiotic use and yet achieve maximum production? (Yes)	50	50
4	Do you think any herbal drugs could be alternative to antibiotics? (Yes)	18	82
5	Do you think seasons and diseases have relation? (Yes)	43	57
6	Would you reduce usage of antibiotics if you knew they are harmful in some sense? (Yes)	100	0
7	In your opinion, only veterinarians are eligible to prescribe antibiotics for poultry? (Yes)	81	19
8	Do you think regular vaccination can reduce the use of antibiotics? (Yes)	70	30
9	Do you think inappropriate use or half course of antibiotics leads to antibiotic resistance? (Yes)	21	79
10	Do you think withdrawal period should be followed before selling eggs of treated birds? (Yes)	10	90
11	Do you think good hygiene practices and vaccination can prevent occurrence of diseases? (Yes)	70	30
Overall level of attitude		**Frequency (%)**	
Positive		67 (67%)	
Negative		33 (33%)	

Table 4. Practices of farmers towards antibiotic usage in layer birds

Practices			
Questions (Correct answer)		**Correct response**	**Incorrect response**
1	Do you use antibiotic by yourself or with veterinarian consultancy? (No)	19	81
2	Do you check expiry date of drugs? (Yes)	81	19
3	Do you use antibiotics as additives for growth promoter in feed? (No)	34	66
4	Do you follow antibiotic withdrawal period? (Yes)	10	90
5	Do you increase dose of antibiotic by yourself if the birds don't recover? (No)	65	35
6	Do you complete course of antibiotics? (Yes)	81	19
7	Do you dispose farm waste near water sources? (No)	81	19
8	Do you sell the eggs of antibiotic treated birds? (No)	5	95
9	Do you use combination of antibiotics? (Yes)	65	35
10	Do you follow vaccination schedules for your flock regularly? (Yes)	17	83
11	Have you ever attended any training to improve the knowledge on antibiotic usage? (Yes)	89	11
12	If flock / some birds get infection, do you use antibiotic in all sheds? (No)	49	51
13	Do you follow proper bio-security measures? (Yes)	100	0
14	Do you maintain records of antibiotics given to flocks in each shed? (Yes)	19	81
Overall level of practices		**Frequency (%)**	
Good		64(64%)	
Bad		36(36%)	

Table 5. Test of statistical significance of variation in the knowledge, attitudes and practices of the farmers towards antibiotic usage

Variables		Knowledge			Attitudes			Practices		
		Correct n(%)	**Incorrect** n(%)	***p*-value**	**Positive** n(%)	**Negative** n(%)	***p*-value**	**Good** n(%)	**Bad** n(%)	***p*-value**
District	**Hisar**	6 (30)	14 (70)	0.61	13 (65)	7 (35)	0.42	16 (80)	4 (20)	0.34
	Panchkula	6 (30)	14 (70)		15 (75)	5 (25)		10 (50)	10 (50)	
	Panipat	10 (50)	10 (50)		10 (50)	10 (50)		12 (60)	8 (40)	
	Karnal	9 (45)	11 (55)		15 (75)	5 (25)		14 (70)	6 (30)	
	Jind	8 (40)	12 (60)		14 (70)	6 (30)		12 (60)	8 (40)	
Farm size	**Small (≤25000)**	10 (40)	15 (60)	0.77	11 (44)	14 (56)	**0.01**	19 (76)	6 (24)	0.22
	Medium (25000-50000)	14 (35)	26 (65)		28 (70)	12 (30)		26 (65)	14 (35)	
	Large (≥50000)	15(42.8)	20(57.14)		28 (80)	7 (20)		19(54.28)	16(45.71)	
Type of feed used at farm	**Self-made**	17 (47.2)	19 (52.7)	0.20	26 (72.2)	10 (27.7)	0.40	24 (66.6)	12 (33.3)	0.67
	Commercial	22 (34.3)	42 (65.6)		41 (64.06)	23 (35.9)		40 (62.5)	24 (37.5)	
Feeding schedule	**Twice**	33 (38.3)	53 (61.6)	0.75	57 (66.2)	29 (33.7)	0.70	53 (77.9)	33 (38.3)	0.22
	Thrice	6 (42.8)	8 (57.1)		10 (71.4)	4 (28.5)		11 (78.5)	3 (21.4)	
Age of farmer	**≤40**	13 (41.9)	18 (58.06)	0.88	20 (65.51)	11 (35.48)	0.93	19 (61.29)	12 (38.7)	0.35
	40-50	16 (30.02)	25 (60.98)		28 (68.28)	13 (31.7)		24 (58.53)	17 (41.46)	
	≥50	10 (35.71)	18 (64.29)		19 (67.85)	9 (32.14)		21 (75)	7 (25)	
Training of poultry farming	**Ancestral**	16 (45.71)	19 (54.29)	0.31	25 (71.43)	10 (28.57)	0.30	24 (68.57)	11 (31.43)	0.77
	Friends	12 (29.27)	29 (70.73)		29 (70.13)	12 (29.27)		25 (60.98)	16 (39.02)	
	Professional institution trained and Others	11 (45.83)	13 (54.17)		13 (54.17)	11 (45.83)		15 (2.50)	9 (37.9)	
Experience in poultry farming	**≤10 years**	7 (28)	18 (72)	0.31	17 (68)	8 (32)	0.93	18(72)	7 (28)	0.17
	10-20 years	18 (39.13)	28 (60.87)		30 (65.22)	16 (34.78)		25 (54.35)	21 (45.65)	
	≥20 years	14 (48.28)	15 (51.72)		20 (68.97)	9 (31.09)		21 (72.41)	8 (27.59)	
Level of Education	**12th grade**	13 (61.9)	8 (38.10)	**0.01**	14 (66.67)	7 (33.33)	0.97	11 (52.38)	10 (47.62)	0.21
	Graduate	26 (32.91)	53 (67.09)		53 (67.09)	26 (32.91)		53 (67.09)	26 (32.91)	

p<0.05- The mean difference was significant at 5% level

Table 6. Logistic regression analysis of the factors associated with farmer's knowledge, attitudes and practices towards antibiotic usage

Variables		Knowledge	Attitudes	Practices
		OR, 95% CI, *p*-value	OR, 95% CI, *p*-value	OR, 95% CI, *p*-value
District	**Hisar**	0.64,0.11-3.81,0.62	0.88,0.17-4.74,0.89	2.43,0.45-13.24,0.31
	Panchkula	0.51,0.09-2.84,0.44	0.71,0.12-4.10,0.70	0.66,0.14-3.18,0.61
	Panipat	5.39,0.91-31.86,0.06	0.59,0.11-3.21,0.54	1.27,0.25-6.43,0.77
	Karnal	3.24,0.65-16.11,0.15	1.17,0.22-6.28,0.85	1.39,0.29-6.78,0.68
	Jind	*	*	*
Farm size	**Small (≤25000)**	1.04,0.23-4.70,0.96	0.12,0.03-0.55,**0.01**	1.81,0.43-7.67,0.42
	Medium (25000-50000)	0.92,0.25-3.39,0.90	0.53,0.13-2.16,0.38	1.36,0.40-4.63,0.63
	Large (≥50000)	*	*	*
Type of feed used at farm	**Self-made**	5.08,1.49-17.25,**0.01**	1.19,0.39-3.57,0.76	1.49,0.51-4.34,0.47
	Commercial	*	*	*
Feeding schedule	**Twice**	0.53,0.13-2.25,0.39	0.70,0.16-3.07,0.64	0.42,0.09-2.00,0.28
	Thrice	*	*	*
Age of farmer	**≤40**	1.32,0.39-4.51,0.65	0.83,0.24-2.90,0.77	0.44,0.13-1.51,0.19
	40-50	1.15,0.35-3.76,0.82	0.98,0.16-3.07,0.64	0.36,0.11-1.19,0.09
	≥50	*	*	*
Training of poultry farming	**Ancestrol**	0.63,0.14-2.84,0.55	4.44,0.87-22.72,0.07	1.09,0.24-4.95,0.92
	Friends	0.54,0.13-2.25,0.40	1.82,0.44-7.57,0.41	0.93,0.22-3.82,0.91
	Professional institution trained and Others	*	*	*
Experience in poultry farming	**≤10 years**	0.27,0.05-1.47,0.13	3.27,0.54-19.83,0.20	0.72,0.13-4.08,0.71
	10-20 years	0.50,0.13-1.89,0.31	1.54,0.39-6.06,0.54	0.37,0.09-1.52,0.17
	≥20 years	*	*	*
Level of Education	**12th grade**	5.65,1.52-20.93,**0.01**	0.60,0.16-2.27,0.46	0.54,0.16-1.79,0.31
	Graduate	*	*	*

**- Reference value*

p<0.05- The mean difference was significant at 5% level

Table 7. Correlations between knowledge, attitudes and practices

		Knowledge	Attitudes	Practices
Knowledge	**Correlation Coefficient**	1	-0.049	-0.041
	Sig. (2-tailed)	-	0.626	0.685
Attitudes	**Correlation Coefficient**	-0.049	1	0.05
	Sig. (2-tailed)	0.626	-	0.624
Practices	**Correlation Coefficient**	-0.041	0.05	1
	Sig. (2-tailed)	0.685	0.624	-

4. DISCUSSION

This survey, the first of its kind among layer farmers in Haryana, aimed to assess their KAP (knowledge, attitudes, practices) towards antibiotic use, with a 100% response rate indicating high participation. Notably, all respondents were male, reflecting cultural norms where poultry farming is seen as a male occupation [19]. The mean scores showed that 39% had correct knowledge, 67% had positive attitudes and 64% followed good practices regarding antibiotic use. The survey also captured potential seasonal patterns in antibiotic use. Farmers showed limited knowledge of antibiotic resistance (56%), consistent with findings from other countries [20,21]. Antibiotic resistance is a global issue, worsened by practices such as using antibiotics without veterinary consultation. This may stem from a lack of strict regulations in animal husbandry [22]. Most farmers (90%) were unaware of withdrawal periods, leading to the sale of antibiotic-contaminated eggs, a serious food safety concern [23].

Although 67% of farmers had positive attitudes, only 18% considered herbal alternatives and 70% recognized vaccination's role in reducing antibiotic use. Despite this, only 17% adhered to proper vaccination schedules and 95% sold eggs from antibiotic-treated birds, indicating the need for better guidance on judicious antibiotic use to combat resistance. Farm size was linked to positive attitudes towards antibiotic use, similar to findings in Bangladesh [21]. Farmers using self-made feed had better antibiotic knowledge, aligning with studies in Kenya [24]. Interestingly, those with education up to 12th grade had better knowledge than graduates, possibly due to a greater eagerness to learn and engage in training, as seen in Bangladesh [25]. Contrary to previous studies in Africa and Bangladesh [12,21], Pearson's test found no significant correlation between farmers' KAP in this survey.

5. CONCLUSION

KAP of farmers plays an important role in determining antibiotic usage at farms. Lack of strict legislations, restrictions on antibiotic use and farmer's self-prescription of antibiotics to the flock are highly accountable for the increasing antibiotic resistance and production of residues contaminated foods of animal origin posing a serious threat to public health globally. In present study, farmers owning small sized farms and using self-made feed had positive attitude towards antibiotic usage. Additionally, farmers who had education up to 12th grade showed better knowledge of antibiotic usage. Hence, for the better understanding of antibiotic usage and antibiotic resistance, there is a need of improving awareness among layer farmers through effective communication, education and training. This study was an attempt to assess the associated factors that mainly influence the KAP of the farmers. It is a remarkable fact that lack of awareness regarding the consequences of the irrational use of antibiotics by layer farmers over a long period is a serious matter of public health concern [26]. In the view of combating the drivers of antibiotic resistance and ensuring good efficacy of antibiotics used in the treatment of animals and humans, strict regulations should be placed to control the non-prudent use of antibiotics in food producing animals [27]. Also, the judicious antibiotic usage by layer farmers is important to prevent the escalating problem of antibiotic resistance and thus preventing unacceptable health risks to the human and animal population [28-31].

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

Participation in the study was on a voluntary basis and the farmers were informed in advance about the purpose of the study. The response to the questionnaire constituted the participant's written consent.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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