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Research Article

PREVALENCE OF MULTIDRUG RESISTANCE *Proteus mirabilis* IN LOCAL AND IMPORTED CHICKEN MEAT FROM VARIOUS AREAS IN BAGHDAD GOVERNORATE

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Abstract

The current study aimed to highlight the prevalence of *Proteus mirabilis* in local and imported chicken meat from various areas in Baghdad, Iraq. This study was conducted in the Department of Veterinary Public Health, Laboratory of Meat Hygiene from September 2020 to January 2021, where the samples of chicken meat were collected under chilled conditions from Baghdad's local markets, and all health aspects were considered when transferring these samples to the laboratory in order to prevent its contamination. The samples were inoculated on plates of specific *Proteus* agar, Blood agar, and MacConkey agar. The isolated bacteria were identified using colony morphology, Gram stain, MDPDP agar, and confirmed its diagnosis by API 20E kits, Vitek2 system, and the first part of this investigation includes the collecting of 200 samples (100 local chicken meat and 100 imported chicken meat) from various sites in Baghdad city. It was identified from total samples (200), 38 (19 %) positive samples, which 11 isolates from imported chicken meat and 27 isolates from local chicken meat. The results also showed that there were significant differences at the level (P≤0.05) of the mean count of *P. mirabilis* from imported chicken meat samples (5.66±0.12) compared to the local chicken meat samples (5.84±0.03) in Baghdad governorate. In conclusion, the prevalence of *P. mirabilis* from local chicken meat samples are more than imported chicken meat samples which conferring significant public health concern. Also, the MDR problem of *P. mirabilis* isolated strains it was resistant to Ticarcillin, Meropenem, Minocycline, Gentamicin and Tobramycin.

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1. Introduction

Bacterial drug resistance is a globally public health problem, and one important cause of it is the multidrug bacterial isolates of animal origins acting as an important source for human infections (Sanches *et al.*, 2019; Thi *et al.*, 2017). The emergence of multidrug-resistant (MDR) *P. mirabilis* has been increasingly reported in the last few years (Wong *et al.*, 2013; Al-Bassam *et al.*, 2013). The resistance of *P. mirabilis* is becoming more complicated and serious year by year, especially the manifestation of resistance to carbapenem drugs, making the prevention and control of the disease face greater challenges (Van *et al.*, 2017). *Proteus* sp. were moderately sensitive to ciprofloxacillin, ciprofloxacillin appeared to be the drug of choice for the treatment of urinary

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tract infection (Alam *et al.,* 2017; Qaddoorri *et al.*, 2015). *P. mirabilis* was naturally resistant to penicillin G, oxacillin, all tested macrolides, lincosamides, streptogramins, glycopeptides, rifampicin and fusidic acid. The species were uniformly, naturally sensitive to all tested aminoglycosides, acylureidopenicillins, some cephalosporins, carbapenems, aztreonam, quinolones, sulfamethoxazole and co-trimoxazole. Species-specific differences in natural susceptibility affecting clinical assessment criteria were seen with tetracyclines, several β1-lactams, chloramphenicol and nitrufurantoin. *Proteus mirabilis* was naturally resistant to all tested tetracyclines, and was naturally sensitive to all β1-lactams, except penicillin G and oxacillin (Stock *et al.*, 2003). The routine use of antibiotics in both medical and veterinary medicine has resulted in wide spread antibiotic resistance and development of antibiotic resistance genes especially within the Gram negative organisms (Hamzah, 2010; Hawkey, 2015).

Drug resistance genes and drug resistance gene islands, such as the extended-spectrum β-lactamase gene (bla_{VEB-6}), have been found in *P. mirabilis* in many countries (Al-Jumaily and Zgaer, 2016; Eliane *et al.*, 2020). Also, the acquired quinolone resistance gene (*qnrA1*) was isolated from humans and animals in France (Siebor *et al.*, 2011; Turki, 2012). In recent years, it has been considered to be a repository for virulence and resistance genes and has become a potential public health concern. Previous studies indicated that severe drug resistance had been developed in *P. mirabilis* against commonly used antibiotics. Thus, the emergence of drug-resistant strains has posed clinical difficulties and become a potential threat to public health (Cernohorská *et al.*, 2011). Multidrug resistant *P. mirabilis* was prevalent in poultry products, The resistance profiles of this bacterial species to antibiotics were associated with those drugs that are frequently used in the poultry industry, the results of some studies therefore indicate the potential possibility that the commonly used antibiotics, such as tetracycline, streptomycin, kanamycin, and gentamicin, may become ineffective in treating bacterial infections that are caused by multidrug resistant *P. mirabilis* a few strains of *P. mirabilis* are also resistant to nalidixic acid. Existing of drug resistance bacteria in meat is a series of health concern and beta-lactamase is responsible to generate multi drug resistances in bacteria.

Recently *Proteus* bacteria developed drug resistance against many antimicrobial drugs and it causes difficulty in patient's treatment. Hence it's important to indicate the rate of *Proteus* spp., *P. mirabilis* and *P. vulgaris*, in the meat of different animals and to find the prevalence of b-lactamase resistance genes, the spread of Multidrug resistant (MDR). *P. mirabilis* isolates producing extended-spectrum β-lactamases (ESBLs) is constantly increasing worldwide. For example, to name a few, *P. mirabilis* strains harboring bla_{CMY2} were observed in Ireland (Ahmed, 2015; Mac Aogain *et al.*, 2016).

Poor hygienic conditions in the traditional market frequently led to an increased the possibility of bacterial contamination in chicken meat, including *Proteus mirabilis*, which causes a foodborne disease in humans (Mangal *et al.*, 2016). Previously, *P. mirabilis* is known as a harmless bacteria to human health (Hola *et al.*, 2012). However, some novel strains have been reported to pose risks to human health and may cause serious disease in patients. In recent years, more and more food poisoning cases associated with *P. mirabilis* had been reported. It can cause serious and persistent infections in humans, such as in the gastrointestinal tract (Sun *et al.*, 2020). Many cases of food poisoning outbreaks was reported for example, 256 students in a middle school were diagnosed with food poisoning of *P. mirabilis* in Zhejiang Province in 1998 (Liu and Lu, 2000); 34 people were diagnosed with food poisoning of *P. mirabilis* in Guangxi Province in 2006 (Liang *et al.*, 2007) and four people were identified to have food poisoning of *P. mirabilis* in Beijing in 2013 (Huo *et al.*, 2014). According to a surveillance report of bacterial food poisoning issued by Datong Food and Drug Inspection and Testing Centre, food poisoning incidents related to *P. mirabilis* accounted for 3.61 % in the food

poisoning incidents reported in Datong from 2016 to 2017 (Shanxi Province, China). It is an important zoonotic conditional pathogen that often causes human and animal infections. *Proteus* genus members are saprophytic normal flora or opportunistic pathogens that cause many diseases when they invade locations outside of their usual habitat (Gupta *et al.*, 2014). It can cause serious and persistent infections in humans (Sun *et al.*, 2020) such as in the respiratory tract, wound infections, eye infections, and gastrointestinal and urinary tract infections (Sanches *et al.*, 2020). While *Proteus* spp. are widely recognized as pathobionts and the gut is the reservoir of these bacteria, it is an opportunistic pathogen often associated with a variety of human infections acquired both in the community and in hospitals.

2. Material and Methods

Isolation of *Proteus mirabilis*

Tow hindered (200) samples divided to (100) of local and imported chicken meat samples to each groups, These samples were taken from different places in the Baghdad governorate, where 100 samples of frozen imported chicken meat were taken from different markets and stores, in addition to the other 100 samples of local chicken meat taken from different slaughterhouses. Chicken meat carcasses for both groups were taken and preserved in special sterile bags under hygienic conditions and taken directly to the laboratory for the analysis .Twenty-five grams of each sample was blended with 225 ml of Tryptone Soy Broth and homogenized using a stomacher under a septic conditions, and incubated aerobically at 37°C for 24 hours. The decimal dilutions were prepared. (1) ml was serially diluted in (1.0 %) (wt/v) peptone water and pour plate on different media then incubated aerobically at 37 °C for 24 hrs. Colonies after incubation period where counted.

Identification by EPI20

Biochemical tests such as catalase and oxidase tests was performed according to Chauhan and Jindal (2020), Urease test according to (Macfaddin, 2000), Phosphatase test according to Satta *et al.* (1979). Bacterial isolates were further identified using a system of index as an Analytical profile (API 20E) based on the recommended approach (Bio Merieux company). Such a system is considered for the performance of twenty standard biochemical tests, including LDC, ODC, Citrate utilization (CIT), H_2S production, Inositol (INO), Mannitol (MAN), glucose (GLU), Sorbitol (SOR), Melibiose (MEL), Rhaminose (RHA), Arginine dehydrolase (ADH), Gelatinase (GEL), Arabinose (ARA) and Voges (OX). Suspension of bacteria was performed for isolates as a whole from pure colonies isolated using suspension as API medium, with turbidity set to 0.5 McFarland tube (1×10^8 CFU/ ml). Using a sterile Pasteur pipette, the bacterial suspension was transferred to twenty micro-tubes and inoculated according to the manufacturer's instructions. Incubation was carried out for 24 hours at 37 degrees Celsius, with isolates being identified using the API (Numerical coding) technique for validating species levels identification. Individual reactions were allocated to positive and negative tests based on numerical values (Swanson and Collins, 1980). The API 20 E analytical profile index was used to identify the seven digital profile numbers.

Identification and Antibiotic sensitivity test by VITEK@2 system

The identified *P. mirabilis* isolates were confirmed with the automated VITEK@2 compact system by using GN/ ID cards. The GN ID card is based on established biochemical methods (64 reactions) .The technique was used to validate the identification of Gram positive and Gram negative microorganisms by using Colorimetric reagent cards that were automatically incubated and analyzed (Zakrzewski *et al.*, 2022). Minimum Inhibitory Concentration (MIC) antibiotics were used by VITEK@2/AST, such as (AST-GN084, AST-GN093 Card system), as mentioned in Table - 1. *P. mirabilis* isolates were identified utilizing the automated VITEK@2GN/AST compact system and MIC method determination with ASTN084 and ASTN093 cards. Ticarcillin, Ticarcillin/Clavulanic acid, Piperacillin,

Piperacillin/Tazobactam, Ceftazidim, Cefepime Ticarcillin, Ticarcillin/Clavulanic acid, Aztreonam, Imipenem, Meropenem, Amikacin, Gentamicin, Tobramycin, Ciprofloxacin q256, Minocycline/Trimethoprim, Sulfamethoxazole (Campaign BioMérieux). In order to identify a category interpretation, the MIC result must be connected to an organism identity. CLSI-defined meanings of MIC was reported by Lynch (2016).

Statistical Analysis

Statistical analysis of data was performed using SAS (Statistical Analysis System - version 9.1). One and two-way ANOVA and Least significant differences (LSD) post hoc test were performed to assess significant differences among means. Chi square was also used to assess the significant differences among percentages ($P < 0.05$) was considered statistically significant.

3. Results and Discussion

The isolation of *P. mirabilis* in foods of animal origin such as Chicken meat is poorly documented and should not be neglected, in view of the zoonotic risk this bacteria can effect negatively to human health. Thus, the present study shed light on the prevalence of *P. mirabilis* in chicken meat samples and sensitivity profile to the different types of antibiotics. This is one of few studies in Iraq conducted the detection of *Proteus mirabilis* from chicken carcasses and demonstrate its role in food poisoning cases in human. Percentage of positive samples of *proteus mirabilis* from chicken meat samples in different area in Baghdad governorate as shown in the Table - 1.

Table – 1: Percentage of Positive samples of *Proteus mirabilis* in different Territories of Baghdad governorate

Territory	*Proteus mirabilis* isolated from chicken samples in Baghdad					
	Total imported chicken samples /area	% Positive samples		Total local chicken samples/area	% Positive samples	
Bisimaya	10	0	0	10	3	30 %
Abu gharib	10	2	20 %	10	4	40 %
Bab almueatham	10	2	20 %	10	3	30 %
Alghazalih	10	2	20 %	10	3	30 %
Baghdad aljadiduh	10	1	10 %	10	3	30 %
Alhabibih	10	0	0	10	2	20 %
Karaduh	10	1	10 %	10	2	20 %
Almahmudih	10	0	0	10	2	20 %
Aleadl	10	1	10 %	10	3	30 %
Alnahdoh	10	2	20 %	10	2	20 %
Total samples	100	11 (11 %)	11 %	100	27 (27 %)	27 %
P-value	<0.01					

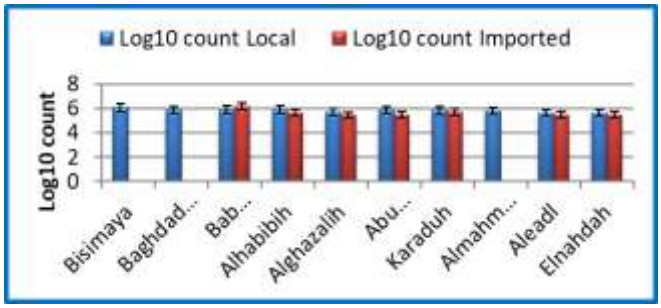


Figure - 1: Mean log[10] of *proteus mirabilis* from chicken meat samples in different area in Baghdad governorate

Samples were gathered from 10 different places, including Bisimaya, Abwgharib, Babalmueatham, Al-ghazalih, Baghdad-Al-jadiduh, Al-habibih, Karaduh, Al-mahmudih, Aleadl, and Elnahdoh. From a total of entire imported and local 200 samples taken 38/200 (19 %) isolates of *P. mirabilis* were identified. The log count of *P. mirabilis* between Territories demonstrated insignificant differences at the same statistical level, the detection percentage was 11/100 (11 %) from imported chicken meat isolated from various locations district and 27/100 (27 %) from local chicken meat in the same districts (Table - 2).

Table - 2: Mean log[10] of *P. mirabilis* from chicken meat samples in different area of Baghdad governorate

Territory	Log_{10} count (Local)	Log_{10} count (Imported)
Bisimaya	A6.08±0.02a	B0.00±0.00c
Baghdad aljadiduh	A5.89±0.06a	B0.00±0.00c
Bab almueazam	A5.91±0.02a	A6.19±0.54a
Alhabibih	A5.91±0.05a	A5.64±0.01b
Alghazalih	A5.74±0.10a	A5.44±0.02b
Abu gharib	A5.89±0.06a	A5.46±0.04b
Karaduh	A5.84±0.003a	A5.70±0.01b
Almahmudih	A5.78±0.10a	B0.00±0.00c
Aleadl	A5.63±0.02a	A5.50±0.02b
Elnahdah	A5.66±0.001a	A5.50±0.002b
LSD	0.43	

Means with a different small letter in the same column are significantly different (P<0.05)
Means with a different capital letter in the same row are significantly different (P<0.05)

Table - 3: Mean log_{10} of *Proteus mirabilis* from Chicken meat samples in Baghdad governorate

Groups	Log_{10} count
Local	5.84±0.03a
Imported	5.66±0.12b
LSD	0.11

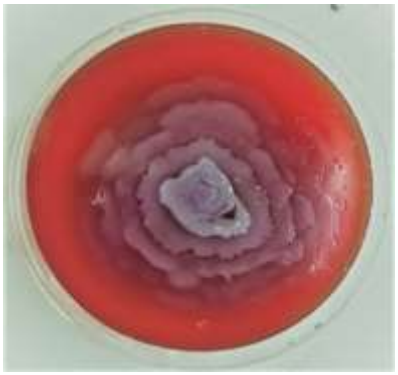
Percentages of *P. mirabilis* recovery from selected districts in Baghdad governorate show significant differences at level (P≤0.05) between local and imported chicken meat with the highest isolation rate of *P. mirabilis* from local chicken meat in the districts (Abu gharib, Bab-Al-mueazam, Al-ghazalih, Aleadl, and Baghdad Al-jadiduh) as 27/100 (27 %) compared to 11/100 (11 %) from important chicken meat samples mean log_{10} of meat chicken carcasses respectively showed in Table (3). another study done in India by Dadheech *et al.* (2015) who found that the overall recovery of *P. mirabilis* strains isolated from chicken carcasses was 25 %. The result of this present study revealed that the recovery rate of *P. mirabilis* from chicken meat (19 %) are lowest from the range as reported by Yu *et al.* (2021) in Belgium when *P. mirabilis* was isolated from 29 out of 80 broiler carcasses (36.25 %) with a mean contamination level of 2.25 ± 0.50 log_{10}

CFU/g. Also, In Navarra, Spain Results show poultry as the meat product having the highest prevalence (84 %) of *P. mirabilis* comparing with other enteric bacteria (Ojer-Usoz *et al.,* 2013). Also, result of this study was higher than those reported by Algammal *et al.* (2021) which the prevalence of *P. mirabilis* in the examined samples was 14.6 % (35/240). Other study which obtained in Bangladesh showed a link between the spread of *Proteus* in poultry fields and its transmission to humans, Findings (38.6 %) *P. mirabilis* in chicken droppings (Nahar *et al*., 2014) while in Brazil (32 %). *P. mirabilis* strains isolated from chicken carcasses in a poultry slaughterhouse in the north of the state of Paraná, in order to assess a potential zoonotic risk (Sanches *et al*., 2019).

Also our results in local chicken meat were agree with those reported by Jiang *et al*. (2017) in China, a total of 52 *P. mirabilis* isolates (29.2 %) were detected from 178 samples which cause gastroenteritis, urinary tract infections, and wound infections. The ingestion of food contaminated by *Proteus* may contribute to the sporadic and epidemic cases of gastroenteritis, this cause symptoms such as vomiting, fever, abdominal pain, severe nausea, diarrhea, and dehydration (Banning, 2006). The contamination of meat with *P. mirabilis* could be attributed to the washing of carcasses with water contaminated with *P. mirabilis* and poor hygiene during processing and meat cutting and grinding. Additional interventions to help improve food safety are applied during processing including heating, chilling, freezing, drying, fermentation, decontamination processes are applied to carcasses such as physical and chemical interventions. Use of chemicals such as acidulants or antimicrobials, packaging, proper storage and distribution, and appropriate meat handling and preparation for consumption. The poor handling of raw meat and fat materials as well as inadequate sanitary measures during processing consider as the main cause for contamination of meat products with *Proteus* spp. (Mahmoud and Hamouda, 2006). Microbial contaminations occur through the processing, which can be prevented by good hygienic and manufacturing practices (Lateef *et al.,* 2010).

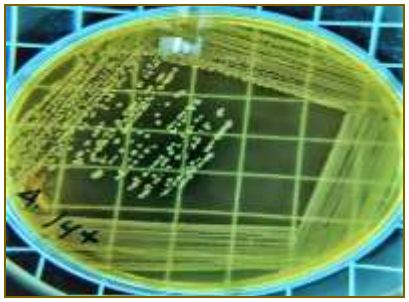
The recommended microbiological criteria for fresh meat are usually ($>10^4$ - $<10^5$) (FAO, 2012). The higher bacterial counts obtained during this study may be due to surface contamination of meat and unwashed workers hands due to the poor hygienic measures observed in Baghdad slaughterhouses and markets. The carcasses can be contaminated with pathogenic microorganisms mainly during the different steps of processing and manipulation e.g. bleeding, skinning and evisceration and storage This fact was supported by Abdelsadig (2006) who stated that contamination in slaughterhouses comes from different sources, mainly hides, air, water, equipment, intestinal contents workers and slaughtering floor. Significant increases in total bacterial counts at Skinning points and at washing operations were also evident (Ali, 2012). Stated that fecal matter constituted a major source of contamination through direct deposition or indirectly through contact with equipment, workers, installations and environment. Chicken and their environments were also shown to be an important source of *P. mirabilis* that constitutes a hazard to human who consume contaminated meat and meat products (Elder et *al.,* 2000). Inappropriate practices e.g. dirty workers hands, clothes and equipment of the slaughterhouse acted as intermediate sources of contamination of meat (Abdelsadig, 2006). According to Doyle *et al*. (2000) chopping boards in households are the reason for cross contamination of meat with microbial pathogens of animal origin. By identifying the locations of microbial hazards, consumers can take appropriate measures to prevent or avoid those hazards throw household hygiene. *P. mirabilis* have been isolated from a variety of foods, such as fish, shrimps, meat, meat products, milk and vegetables, with total counts ranging from 10^2 cfu/ml to 10^9 cfu/ml (Samy *et al*., 2017). The mean $\log_{10}$ of *Proteus mirabilis* (cfu/g) indicates significant differences between local and imported chicken meat, in local chicken meat showed statistically significant increase from imported chicken meat at level ($P \leq 0.05$) as

showed in Table - 3. Based on visual and cultural features on particular medium, blood agar, and MacConkey agar, as well as biochemical testing, the primary isolation was identified as *Proteus mirabilis.* Figure - 2. This study found *Proteus* bacteria as a preliminary diagnosis on blood agar, which agrees with the research results of Mansouri *et al*. (2005), who found that all isolates (100 %) from different clinical sources exhibit B-haemolysin on Blood agar plates and exhibit the swarming phenomenon as well as the fish odor, which agrees with **(Budding *et al*., 2009)**.The results of isolated colonies appear on specified medium as a creamy, convex mucoid shape, circular addition to smooths. While on blood agar, the *P. mirabilis* isolate had a swarming effect on the plate due to the organism's active motility.



A

B



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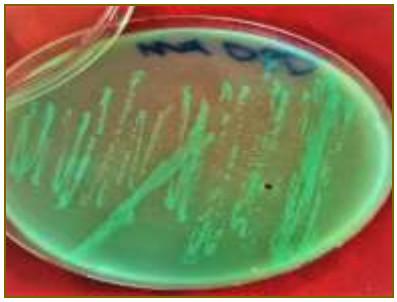

D

E

Figure (2) shows growth *proteus mirabilis* Isolate in (A) *Proteus mirabilis* in blood agar shows swarming phenomena (B-C) *Proteus mirabilis* in specific media shows creamy round convex colony (D) *Proteus mirabilis* in MGPDP agar greenish colony (E) *Proteus mirabilis* in MacConkey agar colorless colony.

P. mirabilis colonies on MacConkey agar appeared pale, yellow, and lactose non fermenters, which matched Pearson's findings (2019), while adding ferric chloride solution to phenylalanine deaminase agar produced positive results for *P. mirabilis*. The *P. mirabilis* isolates, on the other

hand, appear as green colonies in MGPDP (M9) agar as an appositive result of phosphatase production, and in all media *P. mirabilis* isolates have fuel (fishy) odder, which were characteristic feature for the *P. mirabilis.* Xilinas (1975) found that the development of *P. mirabilis* on specified medium was tiny, convex, and creamy. Also, a selective-differential medium is proposed for the preliminary recognition of Enterobacteriaceae from other Gram-negative bacteria directly on primary isolation plates. The results of this method were in almost complete agreement (99 %) with those of the reference identification schemes. Colonies of *P. mirabilis* on agar MGPDP tiny green glossy (phosphatase positive), Phosphatase activity might be a desirable feature for inclusion in tests for Enterobacteriaceae identification. And this is in agreement with Pompei *et al*. (1993). *Proteus mirabilis* a very distinct fishy odor and that agree with Howery *et al.* (2015).

According to Funjan (2021) the API 20E test was applied to different samples from human and animal samples and was used to confirm diagnosis of different isolates. The results of Api 20E technique are show in Table - 4 and Figure – 3.

Table – 4: Api 20E technique of *Proteus mirabilis*

No.	Active ingredients	Symbol test	Results
1.	Ortho NitroPhenyl-Bd-Galactopyranside	ONPG	-
2.	L-arginine	ADH	-
3.	L-Lysine	LDC	-
4.	L-Ornithin	ODC	+
5.	Trisodium citrate	CIT	+
6.	Sodium thiosulfate	H_2S	+
7.	Urea	URE	+
8.	L-tryptophane	TDA	-
9.	L-tryptophane (indole production)	IND	-
10.	Sodiume pyruvate	VP	-
11.	Gelatin (bovine origin)	GEL	+
12.	D-Glucose	GLU	+
13.	D-Mannitol	MAN	-
14.	Inositol	INO	-
15.	D-Sorbitol	SOR	-
16.	L-Rhamnose	RHA	-
17.	D-Saccharose (sucrose)	SAC	-
18.	D-Melibiose	MEL	-
19.	Amygdaline	AMY	-
20.	L-Arabinose	ARA	-

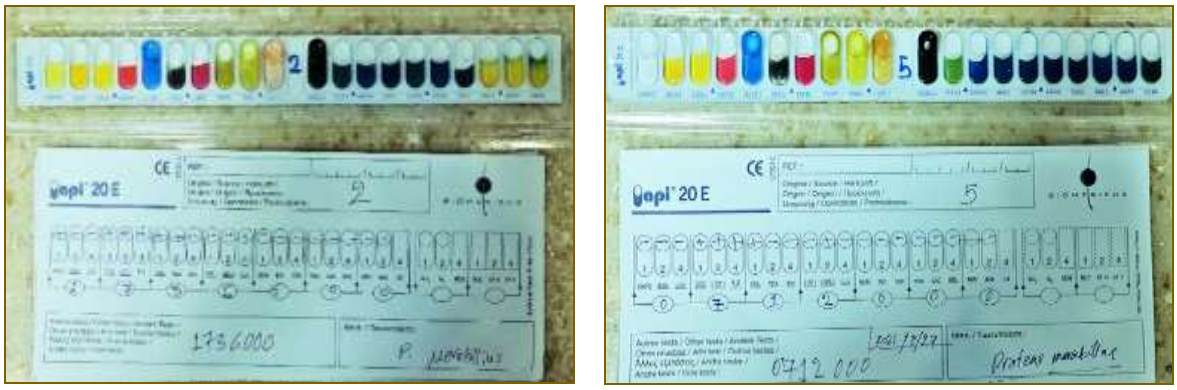

Figure - 3: Api 20 E technique positive result for *Proteus mirabilis*, the numerical profile: (0712000) (1736000) respectively.

The identification by VITEK@2 was performed with the automated VITEK@2 system using GN-ID cards which contained 64 biochemical tests The results were demonstrated (38) isolate dividing to (11) isolates from imported chicken meat and (27) from local chicken meat were confirmed with ID message confidence level ranging excellent (Probability percentage from 96 to 99 %). Vitek2 system confirms the identification of suspected *P. mirabilis* based on the results shown in Figure - 4.

Figure - 4: VITEK@2 Result of *Proteus mirabilis* isolate (99%).

Identification Information		**Card:**	GN			**Lot Number:**	2411530403			**Expires:**	Feb 3, 2022 12:00 CST						
		Status:	Final			**Analysis Time:**	3.87 hours			**Completed:**	Mar 7, 2021 04:04 CST						
Organism Origin		VITEK 2															
Selected Organism		99% Probability				**Proteus mirabilis**											
		Bionumber: 0017000340042210								Confidence: Excellent identification							
Analysis Organisms and Tests to Separate:																	
Analysis Messages:																	
Contraindicating Typical Biopattern(s)																	
Biochemical Details																	
2	APPA	-	3	ADO	-	4	PyrA	-	5	IARL	-	7	dCEL	-	9	BGAL	-
10	H2S	+	11	BNAG	-	12	AGLTp	-	13	dGLU	+	14	GGT	+	15	OFF	+
17	BGLU	-	18	dMAL	-	19	dMAN	-	20	dMNE	-	21	BXYL	-	22	BAlap	-
23	ProA	-	26	LIP	-	27	PLE	-	29	TyrA	+	31	URE	+	32	dSOR	-
33	SAC	-	34	dTAG	-	35	dTRE	+	36	CIT	-	37	MNT	-	39	5KG	-
40	ILATk	-	41	AGLU	-	42	SUCT	-	43	NAGA	-	44	AGAL	-	45	PHOS	+
46	GlyA	-	47	ODC	+	48	LDC	-	53	IHISa	-	56	CMT	+	57	BGUR	-
58	O129R	+	59	GGAA	-	61	IMLTa	-	62	ELLM	-	64	ILATa	-			

The results of *P. mirabilis* identification using the Vitec system showed that all isolates were *P. mirabilis* and the percentage of identification ranged from 95 - 99 %, which was consistent with Chen *et al*. (2017) and Pitout *et al*. (2010) who reported that identification of *Proteus mirabilis* by the Vitek2 system was in the 99 % range. According to Jaber and Almiyah (2022) biochemical testing in the current investigation indicated that all of the resultant isolates likewise belong to the *P. mirabilis* species.

Antimicrobial susceptibility test for *Proteus mirabilis*

The results of antimicrobial susceptibility test of *Proteus mirabilis* isolates from chicken meat sample according to NCCLs shows that resistant of thirty eight (38) isolates (100 %) to Ticarcillin, Piperacillin, Meropenem, Minocycline. While nineteen (19) isolates show resistance with (50 %) and moderate sensitivity of nineteen (19) isolates with (50 %) to Ticarcillin/ Clavulanic Acid were recorded eight (8) isolates show resistance with (21.05 %) and sensitive of (30) isolates with (78.9 %) to Piperacillin/ tazobactam were recorded. Whereas twenty-six (26) isolates showed resistance with (68.4 %) and

sensitive of twelve (12) isolates with (31.5 %) to Ceftazidim were recorded. Totally, 28 isolates showed resistance with 73.7 % and sensitive of ten (10) isolates with 26.3 % to cefepime were recorded. While thirty (30) isolates show resistance with 78.9 % and sensitive of eight (8) isolates with (21.05%) to Aztreonman were recorded. Whereas eighteen (18) isolates show resistance (47.4 %) and sensitive of sixteen (16) isolates (42 %) while moderate sensitive of four (4) isolates (10.5 %) to Imipenem were recorded. While sixteen (16) isolates show moderate sensitive (42 %) and sensitive of twenty-two (22) isolates (57.9 %) to Amikacin were recorded. Whereas twenty (20) isolates show resistance (52.6 %) and sensitive of eight (8) isolates (21.05 %) while moderate sensitive of ten (10) isolates (26.3 %) to Gentamicin were recorded. twenty-four (24) isolates show resistance (63 %) and sensitive of fourteen (14) isolates (36.8 %) to Tobramycin were recorded. twenty-eight (28) isolates show resistance (73.7 %) and sensitive of ten (10) isolates (26.3 %) to Ciprofloxacin were recorded. (38) Isolates show resistance (100 %) to Minocycline. Thirty-six (36) isolates show resistance (94.7 %) and sensitive of two (2) isolates (5 %) to Trimethoprim/Sulfamethoxazole were recorded as shown in Table - 5.

Table – 5: Antibiotic susceptibility test of *Proteus mirabilis* isolated from chicken meat

Antimicrobial	Resistance	Intermediate	Sensitive	P-value
Ticarcillin	38 (100 %)	0 (0 %)	0 (0 %)	<0.0001
Ticarcillin/Clavulanic acid	19 (50 %)	0 (0 %)	19 (50 %)	<0.0001
Piperacillin	38 (100 %)	0 (0 %)	0 (0 %)	<0.0001
Piperacillin/Tazobactam	8 (21.05 %)	0 (0 %)	30 (78.9 %)	<0.0001
Ceftazidim	26 (68.4 %)	0 (0 %)	12 (31.5 %)	<0.0001
Cefepime	28 (73.7 %)	0 (0 %)	10 (26 %)	<0.0001
Aztreonman	30 (78.9 %)	0 (0 %)	8 (21.05 %)	<0.0001
Imipenem	18 (47.4 %)	4 (10.5 %)	16 (42 %)	<0.01
Meropenem	38 (100 %)	0 (0 %)	0 (0 %)	<0.0001
Amikacin	0 (0 %)	16 (42 %)	22 (57.9 %)	<0.0001
Gentamicin	20 (52.6 %)	10 (26 %)	8 (21.05 %)	<0.03
Tobramycin	24 (63 %)	0 (0 %)	14 (36.8 %)	<0.0001
Ciprofloxacin	28 (73.7 %)	0 (0 %)	10 (26 %)	<0.0001
Minocycline	38(100%)	0 (0 %)	0 (0 %)	<0.0001
Trimethoprim/Sulfamethoxazole	36(94.7%)	0 (0 %)	2 (5 %)	<0.0001

4. Conclusions

This research revealed that the prevalence of *Proteus mirabilis* from chicken meat samples are conferring important public health concern. The MDR problem of *P. mirabilis*-isolated strains is serious, it was resistance to Ticarcillin, Meropenem, Minocycline, Doxycycline, Gentamicin, Tetracycline, Nitrofurantoin, and Tobramycin.

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