Iraqi Journal of Veterinary Sciences, Vol. 39, Supplement II, 2025 (111-116)
Proceedings of the 6th Scientific Conference, College of Veterinary Medicine, University of Karbala

Iraqi Journal of Veterinary Sciences

www.vetmedmosul.com

Molecular analysis of certain adhesion genes in *Candida albicans* isolated from chickens with thrush

S.Y. Aldabbagh, M.A. Hamad and B.Y. Rasheed

Department of Microbiology, College of Veterinary Medicine, University of Mosul, Mosul, Iraq

Article information

Article history:
Received 12 May, 2025
Accepted 09 September, 2025
Published 12 November, 2025

Keywords:
ALS1 gene
C. albicans
Chicken
HWP1 gene

Correspondence:
M.A. Hamad
mahmah1073@uomosul.edu.iq

Abstract

Candida albicans causes inflammation in the oral cavity due to its possession of certain virulence genes that enable it to invade the epithelial cells of the mouth. The aims of this study were to molecularly identify *C. albicans* and to detect specific adhesion genes such as ALS1 and HWP1. Eighteen isolates of *C. albicans*, previously isolated from chickens with oral candidiasis in a study conducted at the College of Veterinary Medicine, University of Mosul, were examined in this research. Molecular diagnosis was performed using polymerase chain reaction (PCR), targeting the 18S rRNA, ALS1, and HWP1 genes to detect *C. albicans* and its virulence factors. The results showed that all *C. albicans* isolates produced PCR amplicon products at a molecular weight of 415 bp for the 18S rRNA gene. Additionally, 66% of the isolates yielded PCR amplicon products at a molecular weight of 577 bp for the ALS1 gene. However, all isolates tested negative for the HWP1 gene. Four isolates of *C. albicans* have been registered in GenBank with the following accession numbers: PO328951, PQ328952, PQ328953, and PQ328954. The isolates exhibited 97-100% similarity with global *C. albicans* isolates from China, the USA, and India. The study concluded that the isolates under investigation possess a high percentage of the ALS1 gene, which significantly contributes to their pathogenicity in poultry.

DOI: 10.33899/ijvs.2025.160093.4304,

Introduction

Oral Candidiasis (thrush) in chickens is one of the ecumenical infections that effects on poultry industry. Chickens, turkeys, geese, and parakeets are considered highly susceptible hosts to infection with this form of candidiasis (1). *Candida albicans* is a part of the flora in the oral cavity of the chicken, that is commensals on the mucocutaneous cells in the gastrointestinal tract of chicken (2,3) it is an opportunistic pathogen and causes thrush when the predisposing factors to infection are available as immunosuppressive conditions e.g. debilitation, malnutrition, overcrowding, poor hygiene, young chicken less than 4 weeks and concurrent disease (4). Also, when using the long-term therapy of antimicrobial drugs (5). The main sources for candidiasis are contaminated food or drinking water with *C. albicans* from the environments e.g. human waste, and droppings of birds (6,7). *C. albicans* causes types of inflammation in the mouth, esophageal, gizzard, and crop due to its possessing virulence genes, which permit them to invade the host tissue and avoidance of defense mechanisms (8) as extracellular enzymes, including phospholipases, aspartyl proteases that contribute in adhesion to the epithelium cell, degrade proteins of the extracellular matrix (9,10).In addition, virulence factors of *C. albicans* are very linked with the nature of pathogens as adherence and coaggregation, phenotype switching, interference with the immune system as immunomodulation, and antibiotic resistance (11,12). In the *ALS* (Agglutinin-Like Sequence) gene family, the agglutinin-like sequence is an important family related to adhesions in *C. albicans* (13,14). The members of this family interact with several substrates, including the epithelial cells of the host besides proteins (15,16). Hyphal wall protein 1 (*HWP1*) another

adhesion gene, is regulated at the time of the development of biofilm. HWP1, glycosylphosphatidylinositol (GPI) linked mannoprotein. It is a substrate for transglutaminase activity acquired from a host; thus, it moderates the covalent affinity of *C. albicans* with the host cells (17). *C. albicans* is a Gram-positive microorganism, a polymorphic yeast that reproduces by budding and chlamydospores and forms pseudohyphae (18,19). These features depend on the diagnosis, besides the formation of a germ tube in serum through 2h at 37℃ (20). Molecular diagnosis is important for confirming isolates and detecting the genes that contribute to their virulence (21).

Previous genetic studies of *C. albicans* have detected that virulence factors might be correlated with the genotypic profiles. The molecular diagnosis that is more sensitive and specific therefore has been used for these analyses (10), therefore, this study aimed to detect *C. albicans* molecularly and their Adhesion genes as *ALS1*, and *HWP1*.

Materials and methods

Ethical statement

The Institutional Animal Care and Use Committee (UM.VET.2024.104) 18/8/2024 licensed this study.

Isolates

Eighteen isolates of *C. albicans*, previously isolated from chickens with oral candidiasis in a study conducted at the College of Veterinary Medicine, University of Mosul, were examined in this research. Methods used for isolation and diagnosis of *C. albicans* were mentioned in the study (1). The isolates were enhanced on Brain Heart Infusion agar at 37°C for 18h. and subculture on Sabouraud Dextrose agar at 37°C for 48 h. Then, isolates were confirmed by culturing them on Candida Chromogenic agar (CONDA com, Spain).

Germ tube formation

A germ tube formation test was used to distinguish *C. albicans* from other species, by injecting a one colony of suspected isolates in 0.5 ml of human serum and incubating at 37°C /3 h. (22).

DNA Extraction

All *C. albicans* isolates were subjected to DNA extraction for molecular conformation and detection of *ALS1* and *HWP1*genes, the extraction of DNA was done by using Add Prep Genomic DNA Extraction (Korea) according to the company's instructions, and the DNA concentration was determined using Nanodrop (Nano Photometer® N50/ Germany). The DNA stored in -80 ℃ until used. The 25µl of PCR mixture (1 µl from each primer, 10 µl of GoTaq® G2 Green Master Mix (Promega, USA), 8 µl of DNase-free water, and 5µl of extracted DNA) was used for amplification 18S rRNA gene specific for the detection of *C. albicans*, *ALS1*, and *HWP1*. All primer sequences and amplification cycles (Tables 1 and 2), and amplification was done by using conventional PCR (Sensoquest, Germany) (23,24).

Table 1: Amplification program for genes under study

Type of PCR	Initial denaturation	Cycle numbers 35			Final extension
		Denaturation	Annealing	Extension	
18S rRNA	95/2	94/0.30	59 /0.30	72/1	72/5
ALS1	95/2	94/0.30	58 /0.30	72/1	72/5
HWP1	95/2	94/0.30	59 /0.30	72/1	72/5

Data expressed as ºC/minutes.

Table 2: The primer sequences for genes under the study

Gene primer	Sequence (5' – 3')	Products size	References
18S rRNA	F-GCCGCCAGAGGTCTAAACTT R- AGTTCAGCGGGTAGTCCTAC	415 bp	(25)
ALS1	F-ACATGTACTGTTGAACGACGCT R-GACGACTGCCAGCACAAGTA	577 bp	(26)
HWP1	F-TCTACTGCTCCAGCCACTGA R-TTCAGTGGCAGGACTGATG	501 bp	(27)

Sequencing of *Candida albicans* isolates

After the PCR amplification, the amplicons were sequenced (Macrogen, Korea). Using BLAST, the obtained gene sequences were compared with Partial DNA sequences of the agglutinin-like protein (*ALS1*) gene sequences from other countries that had already been recorded in the GenBank. The phylogenetic tree of *C. albicans* isolated from local chickens in Iraq was organized to utilize the Maximum Likelihood technique based on the Tamura-Nei model in MEGA11 software (28,29).

Results

Germ tube formation:

According to the formation of the germ tube, the results revealed that all isolates formed the germ tube after 2-3 h on incubation on human serum at 37℃ (Figure 1). On Candida Chromogenic agar, all *C. albicans* isolates showed green colonies (Figure 2).

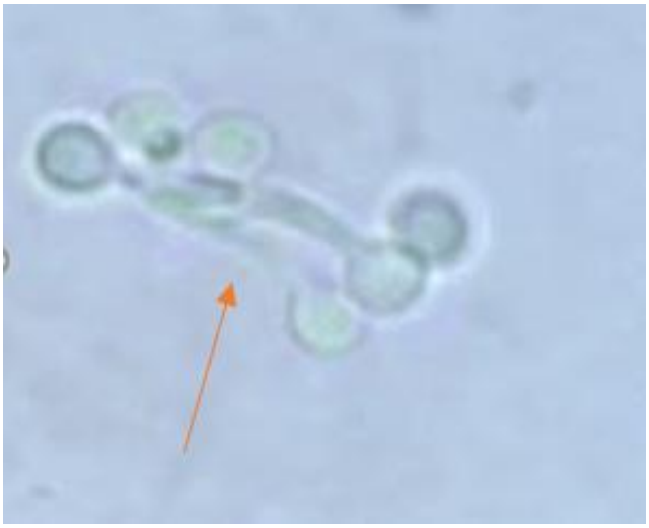

Figure 1: Producing germ tube from *C. albicans*.

Figure 2: *C. albicans* produces green colonies on Candida chromogenic agar.

Molecular detection of *Candida albicans* and their virulence genes

The molecular identification of *18S rRNA* for *C. albicans* gave an amplicon product of 416 bp (Figure 3). The amplification of *ALS1* virulence genes resulted in 577 bp in 66% of *C. albicans* isolates (Figure 4). In contrast, the amplification of the *HWP1* gene yielded negative results for all tested *C. albicans* isolates.

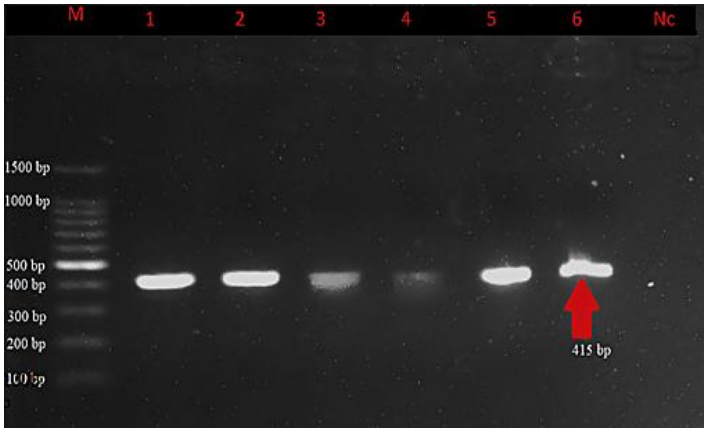

Figure 3: Amplification of the *18S rRNA* gene for *C. albicans* M= 100 bp. marker, 1-6 =positive isolates, Nc= negative control.

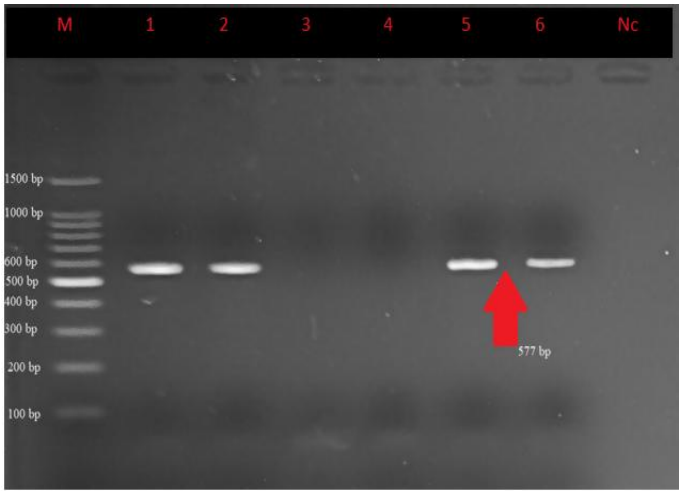

Figure 4: Amplification of the *ALS1* gene for *C. albicans* M= 100 bp. marker. (1-6) positive isolates, Nc= negative control.

Sequencing and phylogenetic tree

The genetic sequence of the isolates was determined, then the query alignment of *C. albicans* with the NCBI GenBank was determined, and its percentage of identity with global isolates was determined (Figure 5). Four isolates of *Candida albicans* were registered in the NCBI with serial numbers PO328951, PQ328952, PQ328953, and PQ328954. The isolates showed a 97-100% affinity with global isolates in China, USA, and India (Table 3). The phylogenetic tree of *C. albicans* isolated in Iraq and the degree of relatedness with global isolates were determined (Figure 6).

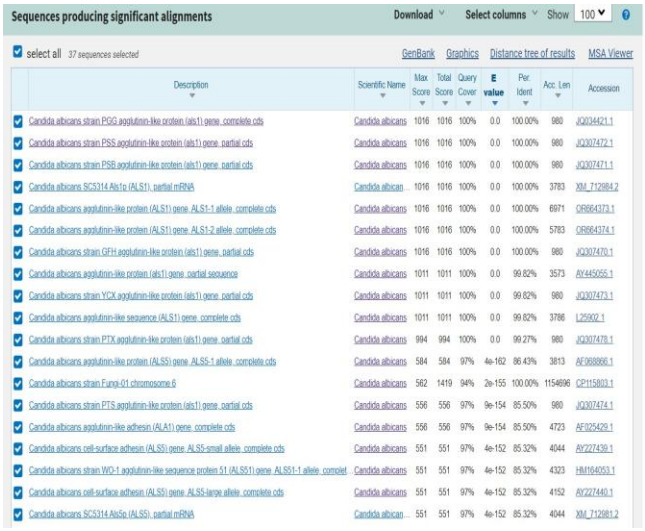

Figure 5: The identification of query *C. albicans* alignment with NCBI GenBank.

Table 3: Distribution of *C. albicans* according to NBLAST in GenBank

Sample	Query %	Identic Number %	Genbank	Country
PQ328951 PQ328952 PQ328953 PQ328954	100	100	JQ034421.1	China
	100	100	JQ307472.1	China
	100	100	JQ307471.1	China
	100	100	XM_712984.2	USA
	100	100	OR664373.1	USA
	100	100	OR664374.1	USA
	100	100	JQ307470.1	China
	100	99.82	AY445055.1	USA
	100	99.82	JQ307473.1	China
	100	99.82	L25902.1	USA
	100	99.82	JQ307478.1	China
	97	97	AF068866.1	USA
	94	100	CP115803.1	India
	97	85.50	JQ307474.1	China
	97	85.50	AF025429.1	USA
	97	85.32	AY227439.1	USA
	97	85.32	HM164053.1	USA
	97	85.32	AY227440.1	USA
	97	85.32	XM_712981.2	USA

Discussion

Candida albicans is an opportunistic pathogen that causes superficial and systemic mycoses in animals, including poultry (30,31). Excessive and incorrect use of medications, hormones, and immunosuppressants in the last few years, in addition to contamination of feed, has led to an increase in the thrush rate in animals and humans (32,33). All isolates used in this study were confirmed in chromogenic agar gave a green color this result is in agreement with (34,35). The germ tube formation test is a rapid and reliable method for diagnosing *C. albicans*. This test is highly specific for *C. albicans*, with a specificity of approximately 99% (36).

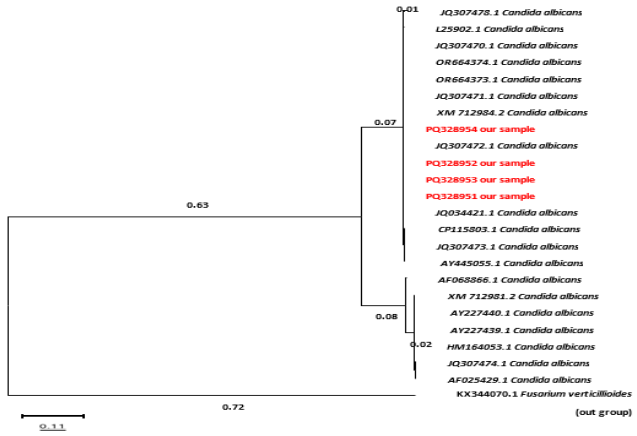

Figure 6: Phylogenetic tree of Candida *albicans* from Iraq (Red color). The phylogenic tree was constructed using the Maximum Likelihood method based on the Tamura-Nei model in MEGA11 software and bootstrap analysis with 1000 re-samplings. Partial DNA sequences of the gene ASL1 were used as input data.

Many studies have focused on the molecular aspect of *Candida* isolated from humans and rarely considered isolates taken from animals, including birds, where it is necessary to focus on distribution and genetic diagnosis to know the epidemiology (37-39). When using molecular detection of the isolates under study, all isolates showed amplification of the (*18S rRNA* gene) with a molecular weight of 415 bp, which is consistent with (26,33). The molecular investigation used provided more sensitive and specific results (10).

C. albicans possesses several virulence factors that aid in adhesion and invasion of the host tissue (40). The results showed the presence of the *ALS1* gene at a rate of 66%, as many studies have shown its presence at a similar percentage (21,31), the *ALS* genes are the largest family responsible for adhesion, as they include a group of genes that interact with the host cells to enable them to anchor and stabilize (41,42).

Hyphal cells play a fundamental role in the growth and spread of Candida, as they invade cells and also damage the tissues. The genes responsible for the production of hyphae are *HWP1*, *ALS1*, and *HGC1* (43,44). The current study showed that all tested *C. albicans* isolates did not contain the *HWP1* gene; this result may be due to the limited number of isolates studied and the methods used (17). This gene is also associated with adhesion, and regulated during biofilm formation (10,45), this result is similar to many studies that showed that at least 195 isolates were negative out of 206 isolates for this gene (21). Earlier studies have revealed that

HWP1 is not expressed during the growth phase of yeast but is highly expressed in hyphal form and germ tube (46). The defects of biofilm formation that are associated with the *HWP1* mutant in vitro and in vivo are completely in agreement with the idea that expression of *HWP1* is specific in hyphae related to biofilm formation (47). Some studies emphasized that *C. albicans* isolated from birds have already been reported in human infections and that these birds and chickens could be considered sources of infection for other animals, and for people as farmers and veterinarians (48).

Conclusion

C. albicans possesses the *ALS1* gene, which is found in a high ratio in the isolates under study, and the *ALS* genes are the largest family responsible for adhesion, interaction with the host cells to enable them to colonize and stabilize, in the outcome participate in the pathogenicity of this yeast. While the tested *C. albicans* isolates did not contain the *HWP1* gene.

Conflict of interest

The authors declare that there is no conflict of interest.

Acknowledgements

The authors would like to thankfulness to the College of Veterinary Medicine, University of Mosul, Iraq.

References

1. Al-Dabbagh SY. Isolation and diagnosis of *Candida albicans* from oral cavity of local chickens and detection of some of the virulence factors in Mosul city. IMDC-SDSP 2020, Cyperspace, 28-30 June 2020. DOI 10.4108/eai.28-6-2020.2298159
2. Benarrós MS, Salvarani MF. Candidiasis in *Choloepus* sp.—A Review of New Advances on the Disease. Animals. 2024; 14: 2092. DOI: 10.3390/ani14142092
3. Talazadeh F, Ghorbanpoor M, Shahriyari A. Candidiasis in birds (*Galliformes, Anseriformes, Psittaciformes, Passeriformes,* and *Columbiformes*): A focus on antifungal susceptibility pattern of *Candida albicans* and non-*albicans* isolates in avian clinical specimens. Top Companion Anim Med. 2022; 46:100598. DOI: 10.1016/j.tcam.2021.100598
4. Henriques M, Silva S. *Candida albicans* virulence factors and its pathogenicity. Microorganisms 2021; 9: 704. DOI: 10.3390/microorganisms9040704
5. Garcês A, Lopes R, Salinas D, Ferreira M, Infante S, Lopes A. First report of oral Candidiasis by *Candida lusitaniae* in a red kite (*Milvus milvus,* Lineu 1758). J Adv Vet Res. 2022; 12(3): 321-323. [https://advetresearch.com/index.php/AVR/article/view/956].
6. Kemoi EK, Okemo P, Bii CC**.** Isolation of Candida species in domestic chicken (*Gallus gallus*) droppings in Kabigeriet village, Nakuru county, Kenya. Eur Sci J. 2013; 9(36). [https://www.semanticscholar.org/paper/3ca214e695403069fed4f5af32362265a0bf824c].
7. Apsemidou A, Füller MA, Idelevich EA, Kurzai O, Tragiannidis A, Groll AH. *Candida lusitaniae* breakthrough fungemia in an immunocompromised adolescent: Case report and review of the literature. J Fungi. 2020; 6(4): 380. DOI: 10.3390/jof6040380
8. Russell CM, Schaefer KG, Dixson A, Gray AH, Pyron RJ, Alves DS, Moore N, Conley EA, Schuck RJ, White TA, Thanh DD, King GM, Barrera FN. The *Candida albicans* virulence factor candidalysin polymerizes in solution to form membrane pores and damage epithelial cells. eLife. 2022; 11: e75490. DOI: 10.7554/eLife.75490
9. Ibrahim Z, Ali BH, Khalid AR, Sami JA, Farhan WH, Hasan MS. Avian Candidiasis: A Review. Int J Pharm Res. 2020; 12 (1):1288-1291. DOI: 10.31838/ijpr/2020.12.01.199
10. Sokół I, Gaweł A, and Bobrek A. Investigation of the correlation between virulence factors and genotypic profiles of *Candida albicans* isolated from turkeys. Polish J Vet Sci. 2018; 21(1): 29–33. DOI: 10.24425/119018
11. Nasution AI. Virulence factor and pathogenicity of *Candida albicans* in oral candidiasis. World J Dent. 2013; 4(4): 267-271. 10.5005/jp-journals-10015-1243
12. Dalvand A, Katiraee F, Joozani RJ, Shokri H. Genotyping of *Candida albicans* isolated from animals using 25S ribosomal DNA and ALT repeats polymorphism in repetitive sequence. Curr Med Mycol. 2018; 4(4):12-19. DOI: 10.18502/cmm.4.4.381
13. Zhao X, Oh SH, Coleman DA, Hoyer LL. ALS1 deletion increases the proportion of small cells in a *Candida albicans* culture population: Hypothesizing a novel role for ALS1. Front Cell Infect Microbiol. 2022; 12: 895068. DOI: 10.3389/fcimb.2022.895068
14. Talapko J, Juzbaši M, Matijevi T, Pustijanac E, Beki´c S, Kotris I, Škrlec V. Identification of chicken-derived antibodies targeting the *Candida albicans* Als3 protein. Appl Microbiol Biotech. 2025; 109(85):1-14. DOI: 10.1007/s00253-025-13469-3
15. Fernandes LM, Goodwine JS, Ricomini-Filho AP, Nobile CJ, Cury AA. *Candida albicans* Adhesins Als1 and Hwp1 Modulate Interactions with *Streptococcus mutans*. Microorganisms. 2023; 11:1391. DOI: 10.3390/microorganisms11061391
16. Liu C, Xu C, Du Y, Liu J, Ning Y. Role of agglutinin-like sequence protein 3 (Als3) in the structure and antifungal resistance of *Candida albicans* biofilms. FEMS Microbiol Lett. 2021; 368(14): fnab089. DOI: 10.1093/femsle/fnab089
17. Melek İİ, Atalay MA, Ozer B, Evirgen O, Duran N, Motor VK, Koc AN, Onlen Y, Durmaz S. Investigations of *ALS1* and *HWP1* genes in clinical isolates of *Candida albicans*. Turk J Med Sci. 2013; 43:125-130. DOI: 10.3906/sag-1205-90
18. Mohammed NA, Ajah HA, Abdulbaqi NJ. Detection of the prevalence of adhesins and extracellular hydrolytic enzymes genes in *Candida albicans* biofilm formation. Iraqi J Sci. 2017; 58(2C): 988-1000. DOI: 10.24996/ijs.2017.58.2C.3
19. Quinn PJ, Markey BK, Carter ME, Donnly WJ, Leonard FC, Maghire D. Veterinary Microbiology and Microbial Disease. USA: Blackwell Publishing; 2020. 23-28 pp.
20. Matare T, Nziramasanga P, Gwanzura L, Robertson V. Experimental germ tube induction in *Candida albicans*: An evaluation of the effect of sodium bicarbonate on morphogenesis and comparison with pooled human serum. BioMed Res Int. 2017; 1:1976273. DOI: 10.1155/2017/1976273
21. İnci M, Atalay MA, Özer B, Evirgen O, Duran N, Motor VK, Koç AN, Önlen Y, Kilinç C, Durmaz S. Investigations of *ALS1* and *HWP1* genes in clinical isolates of *Candida albicans*. Turk J Med Sci. 2013; 43:125-130. DOI: 10.3906/sag-1205-90
22. Zhang S, Zhao O, Xue W, Li Y, Guo Y, Wu Z, Huo S, Liy CH. The isolation and identification of *Candida glabrata* from avian species and a study of the antibacterial activities of Chinese herbal medicine in vitro. Poult Sci. 2021; 100:101003. DOI: 10.1016/j.psj.2021.01.026
23. Koneman EW, Allen SD, Janda WM, Scheckenberger PC, Winn WC. Color Atlas and Textbook of Diagnostic Microbiology. 4th ed. USA: J.B. Lippincott Company; 1992.
24. Forbes BE, Sham DF, Wiessfeld AS. Bailey & Escott's Diagnostic Microbiology. 12th ed. USA: Mosby Elsevier; 2007.
25. Kadhim MA, Abdulameer SJ, Al-Dulaimi OG, Al-Azzawi AK. Isolation and Molecular Identification of *Candida albicans* from the Oral cavity of Domestic Chickens using 28S rDNA in Diyala Governorate, Iraq. J World Poult Res. 2024; 14(2): 124-131. DOI: 10.36380/jwpr.2024.12

26. AL-abedi HH, Khalil II, AL-abedi SH. Molecular detection of virulence factor genes in *Candida albicans* isolated from the oral cavity of local chicken and antifungal susceptibility in Mosul province. Al-Kitab J Pure Sci. 2024; 8(2): 1-10. DOI: 10.32441/kjps.08.02.p1
27. AL-abidy HH, Khudaier BY, AL-Attraqchi AF. Conventional and molecular detection of *Candida albicans* and *Candida parapsilosis* isolated from bovine mastitis in Basrah - Iraq. Biochem Cell Arch. 2019; 19(2): 3285-3289. DOI: 10.35124/bca.2019.19.2.3285
28. Alkhashab AN, Alhaji TA, Thalij KM. Effectiveness of Chitosan and Ag-Nanoparticle Films on the Quality of Chicken Meat. Mesopotamia J Agric. 2024; 52(2): 14-26. DOI: 10.33899/MJA.2024.145729.011337
29. Medina IR, Fuentes LR, Arteaga MB, Valcárcel FR, Arbelo FA, Del Castillo DP, Suárez SD, Quintana OF, Gutiérrez BV, Sergent FS, Acosta-Hernández B. Pigeons and their droppings as reservoirs of Candida and other zoonotic yeasts. Rev Iberoam Micol. 2017; 34(4): 211–4. DOI: 10.1016/j.riam.2017.03.001
30. Jadhav VJ, Pal M. Human and domestic animal infections caused by *Candida albicans*. J Mycopathol Res. 2013; 51(2): 243-249.[https://www.imskolkata.org/pdf/oct_13/6.%20VIJAY.pdf].
31. Lee CH, Wu CJ, Yen FY, Chiang JY, Shen TJ, Leu SJ, Chang CR, Lo HJ, Tsai BY, Mao YC, Andriani V. Identification of chicken-derived antibodies targeting the Candida albicans Als3 protein. Appl Microbiol Biotechnol. 2025; 109(1): 1-4. DOI: 10.1007/s00253-025-13469-3
32. Liu J, Liu H, Yan J, Liu N, Zhang H, Zhao C, Liu Y. Molecular typing and genetic relatedness of 72 clinical *Candida albicans* isolates from poultry. Vet Microbiol. 2018; 214: 36–43. DOI: 10.1016/j.vetmic.2017.11.030
33. Abd El-Tawab AA. Phenotypic and genotypic characterization of *Candida albicans* isolated from chicken. Benha Vet Med J. 2020; 38(2): 120-124. DOI: 10.21608/BVMJ.2020.25501.1185
34. Garcês A. Candidiasis in birds: An Update. J Vet Physiol Pathol. 2023; 2(3): 42-46. DOI: 10.58803/jvpp.v2i3.29
35. Chiang SJ, Chien MK, Tsai CY, Hsiao JG, Koo FH, Yen YF. A Simple, Fast, and Reliable Method for the Identification of *Candida albicans*. Environ Health Insights. 2024; 14(18): 1-5. DOI: 10.1177/11786302241272398
36. Sharma K, Chattopadhya U, Naskar K. Prevalence of *Candida albicans* in raw chicken and mutton meat samples sold in the open markets of Kolkata city of West Bengal. Int J Livest Res. 2017; 7(5): 243-249. DOI: 10.5455/ijlr.20170328034209
37. Nadăş GC, Kalmár Z, Aure M, Chirilă F. Bouari CM, Răpuntean S, Bolfa P, Iosif NF. Comparative identification of *Candida* species isolated from animals using phenotypic and PCR-RFLP methods. J Vet Res. 2014; 58: 219-222. DOI: 10.2478/bvip-2014-0032
38. Souza MN, Ortiz SO, Mello MM, de Oliveira FM, Severo LC, and Goebel CS. Comparison between four usual methods of identification of *Candida species*. Rev Inst Med Trop Sao Paulo. 2015; 57(4): 281-287. DOI: 10.1590/S0036-46652015000400002
39. Mousavi SA, Khalesi E, Shahid Bonjar GH, Aghighi S, Sharifi F, Aram F. Rapid molecular diagnosis for *Candida* species using PCR-RFLP. Biotechnol. 2007; 6(4): 583-587. DOI: 10.3923/biotech.2007.583.587
40. Saiprom N, Wongsuk TH, Oonanant W, Sukphopetch P, Chantratita N, Boonsilp S. Characterization of virulence factors in *Candida* species causing candidemia in a tertiary care hospital in Bangkok, Thailand. J Fungi. 2023;9:353. 10.3390/jof9030353
41. Pinto LM, de Assis Bezerra Neto F, de Medeiros MP, Alves DZ, Chaves GM. Candida species isolated from pigeon (*Columbia livia*) droppings may express virulence factors and resistance to azoles. Vet Microbiol. 2019; 235: 43-52. DOI: 10.1016/j.vetmic.2019.05.022
42. Nailis H, Kucharíková S, Řičicová M, Van Dijck P, Deforce D, Nelis H, Coenye T. Real-time PCR expression profiling of genes encoding potential virulence factors in *Candida albicans* biofilms: identification of model-dependent and –independent gene expression. BMC Microbiol. 2010; 16: 114. DOI: 10.1186/1471-2180-10-114
43. Nobile CJ, Nett JE, Andes DR, Mitchell AP. Function of *Candida albicans* adhesin HWP1 in biofilm formation. Eukaryot Cell. 2006; 5(10): 1604–1610. DOI: 10.1128/EC.00194-06
44. Nunes T, Rosa L, Vega-Chacón Y, Mima E. Fungistatic Action of N-Acetylcysteine on *Candida albicans* Biofilms and Its Interaction with Antifungal Agents. Microorganisms. 2020; 8:980. DOI: 10.3390/microorganisms8070980
45. Ene IV, Bennett RJ. HWP1 and related adhesins contribute to both mating and biofilm formation in *Candida albicans*. Eukaryot Cell. 2009; 8: 1909–13. DOI: 10.1128/EC.00245-09
46. Vieira RG, Acqua SD. Phenotypical characterization of *Candida* spp. isolated from crop of parrots (*Amazona* spp.). Pesq Vet Bras. 2009; 29(6): 452-456. DOI: 10.1590/S0100-736X2009000600002
47. Talapko J, Juzbaši M, Matijevi´ T, Pustijanac E, Beki´c S, Kotris I, Škrlec I. *Candida albicans*—The virulence factors and clinical manifestations of infection. J Fungi. 2021; 7: 79. DOI: 10.3390/jof7020079
48. Razmyar J, Movassaghi AR, Mirshahi A, Eidi S, Zaeemi M. Osteoarthritis and systemic infection caused by *Candida albicans* in acommon Mynah (*Acridotheres tristis*). Iran J Vet Sci Technol. 2014; 6(2): 77-84. DOI: 10.22067/veterinary.v6i2.27859

التحليل الجزيئي لبعض جينات الالتصاق في المبيضات البيضاء المعزولة من الدجاج المصاب بمرض القلاع

سميه ياسين الدباغ، محمد علي حمد و بلسم يحيى رشيد

فرع الأحياء المجهرية، كلية الطب البيطري، جامعة الموصل، الموصل، العراق

الخلاصة

تسبب المبيضات البيضاء التهابًا في التجويف الفموي للدجاج بسبب امتلاكها لبعض مورثات الضراوة، والتي تمكنها من غزو الخلايا الظهارية للفم. هدفت هذه الدراسة إلى التعرف الجزيئي على المبيضات البيضاء المعزولة من الدجاج المصاب بداء المبيضات الفموي (القلاع) والكشف عن بعض مورثات الالتصاق مثل المورث ALS1 والمورث HWP1. خضعت للدراسة الحالية ثمانية عشر عزلة من المبيضات البيضاء المعزولة من الدجاج المصاب بداء المبيضات الفموي في دراسة سابقة أجريت في كلية الطب البيطري / جامعة الموصل. تم إجراء التشخيص الجزيئي باستخدام تفاعل البلمرة المتسلسل. تم استخدام كل من المورثات 18S rRNA و ALS1 و HWP1 للكشف عن المبيضات البيضاء ومورثات الضراوة الخاصة بها. أظهرت الدراسة أن جميع عزلات المبيضات البيضاء أعطت نواتج تضخيم للجين 18S rRNA عند الوزن الجزيئي ٤١٥ زوج قاعدي ، بينما أعطت ٦٦٪ من العزلات ناتج تضخيم عند الوزن الجزيئي ٥٧٧ زوج قاعدي للمورث ALS1 في حين أعطت جميع العزلات نتائج سلبية للمورث HWP1. تم تسجيل أربع عزلات من المبيضات المبيضة في البنك العالمي للجينات بالأرقام التسلسلية PO328951 و PQ328952 و PQ328953 و PQ328954. أظهرت جميع العزلات تشابهًا بنسبة ٩٧-١٠٠% مع عزلات المبيضات المبيضة العالمية في كل من دول الصين والولايات المتحدة الأمريكية والهند. وخلصت الدراسة إلى أن العزلات قيد الدراسة تمتلك نسبة عالية من مورث الالتصاق ALS1 ، مما يساهم بشكل كبير في قدرتها الإمراضية في الدواجن.