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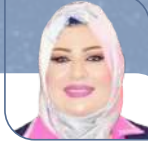
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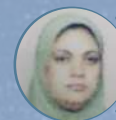
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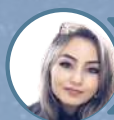
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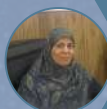
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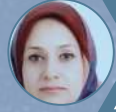
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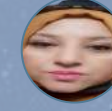
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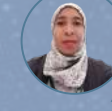
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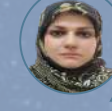
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PREFACE

The 10th International Conference on Applied Sciences and Technology Research "MINAR CONGRESS", was organized by Istanbul Gedik University in collaboration with Remar Academy. The primary objective of this event was to compile and disseminate valuable scientific knowledge and make a meaningful contribution to the future.

Remarkably, a substantial number of researchers, both from local and international backgrounds, demonstrated their interest in this conference. The scientific committee meticulously reviewed the submissions and ultimately accepted a select group of individuals, totaling 55 applicants, 40 of them were accepted by the scientific committee.

This conference was truly a global endeavor, as it drew participation from 7 attendees who joined in person, alongside 33 who engaged in the event remotely. These participants collectively enriched the conference with their expertise and insights.

The core of this conference was the presentation of 40 complete research papers, while the remaining articles and research findings are set to be featured in forthcoming issues of the MINAR Journal.

I would like to extend my sincere appreciation to all the contributors and scholars who played an essential role in making this conference a resounding success. Your dedication and valuable contributions are deeply respected and acknowledged.

Editor-in-Chief
Prof. Dr. Ghuson H. MOHAMMED

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Role of Interleukin-35 In The Pathogenesis of Hashimoto's Thyroiditis Disease

AL-Husnah Adil Mansoor ¹



Abstract

The immune system has the ability to distinguish between self and non-self. Also, Regulatory T-cells are a portion of T-cells that are in charge of preserving regulation of the immune system and immune tolerance through active immune-repression. Immune tolerance is very important to prevent the immune system from interacting against itself and thus to avoid the development of autoimmune diseases. Interleukin-35 (IL-35), which is a member of the interleukin-12 (IL-12) cytokine family, is an anti-inflammatory immune response that plays the important function in the obstruction of the development of autoimmune diseases in different tests autoimmunities. When loss of self-tolerance occurs because many genetic and environmental factors, this causes the absence of balanced anti-inflammatory immune responses, which reduces the in vivo suppressive capacity of Treg, which is taken to be a regular T-cell-linked autoimmune disease., especially Hashimoto's thyroiditis (HT).


Methods: The current study included 90 samples. 60 hypothyroid HT patients (Group 1) and 30 healthy controls (Group 2) were enrolled in the study. Blood samples were collected and separated into serum from the two groups to be used to measure the functions of the thyroid gland by measuring the levels of thyroid hormone and thyroid stimulating hormone, measuring the level of anti-thyroid auto-antibodies, and determining the standard of serum Interleukin-35 through ELISA.


Results: The results of the current study Through statistical analysis using the program SPSS version 22, it was shown that serum IL-35 levels were inversely Correlation used Pearson test with TSH, TPO-Ab, and TG-Ab in patients HT (-.292 ($P \geq 0.01$), -.245 ($P \geq 0.02$), -.269 ($P \geq 0.01$). While serum IL-35 levels were directly correlated with TSH, TPO-Ab, and TG-Ab in healthy controls (.151 ($P \geq 0.01$), .192 ($P \geq 0.01$), .097 ($P \geq 0.01$). The results of the current study showed a highly significant difference in TSH and FT4, respectively ($P \geq 0.01$), between the control and hypothyroid groups. Hypothyroidism is more common in females than males, and the incidence of hypothyroidism steadily increases with advancing age. Thyroid hormone concentrations show a significant change in patients with hormonal hypothyroidism compared with the control group.

Conclusion: Our findings indicate an effective role for interleukin 35 in the reverse association with auto-antibodies and the development of autoimmune diseases, especially Hashimoto's disease.

Key Words *Interleukin-35 ; Autoimmunity ; Hypothyroidis ; Thyroid Peroxidase (TPO) anti-body ; Thyroglobulin (Tg) antibody*

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Introduction

In the body, there is an immune system that consists of special organs and leukocytes that protect the body from foreign invaders. The immune system has the ability to distinguish between self and non-self. When many genetic and environmental factors influence the immune system, the body produces autoantibodies that attack normal cells by error (Ralli et al., 2020). Also, Regulatory T-cells are a portion of T-cells that are in charge of preserving regulation of the immune system and immune tolerance through active immune-repression. Immuno-tolerance prevents the evolution of autoimmune diseases by inhibiting the immune system's fight-to-self antigen and protecting cells and tissue bodies from damage responses (Audiger et al., 2017). Autoimmune thyroid disorders (AITD) are the most ordinary of all autoimmune disorders, representing Hashimoto's thyroiditis as its most severe (Corso et al., 2023). Hashimoto's thyroiditis is predominantly characterized by a T-cell-mediated immune response leading to thyroid destruction and, consequently, often presents with hypothyroidism (Ralli et al., 2020).

Also, Hashimoto's thyroiditis is characterized by progressive destruction of thyroid cells with the presence of antibodies, the most specific of which is the anti-thyroperoxidase (TPO) antibodies, evidence of autoimmunity. Thyroid autoantibodies against thyroid peroxidase and thyroglobulin are often detected (Nafissatou et al., 2021).

Forms Reduction of the Tregs number and loss of self-tolerance to thyroid antigens play an essential role in the onset and evaluation from the autoimmune operation in thyroid disorder, which is especially a hallmark of HT (Yilmaz et al., 2016). Hashimoto thyroiditis (HT) is one of the prevalent, typically thyroid autoimmunity diseases, different from those recognized by hypothyroidism, which causes the gland's insufficiency to produce enough thyroxine to meet the body's needs. This insufficient amount of hormone affects body processes and damages tissues and organs throughout the body (Jonklaas et al., 2011).

In 1912, Japanese physician Haraku Hashimoto first described HT, finding that thyroid tissue was infiltrated by lymphocytes. In 1956, anti-thyroglobulin antibodies [thyroid peroxidase (TPO) and/or thyroglobulin (Tg) antibodies] were isolated from the serum of patients with HT by Roitt, Doniach, et al. Therefore, we found an immunological reaction to TPO and/or TG in the patients with hashimoto thyroiditis. Currently, HT is a more important thyroid disease, and its incidence is (0.3–1.5) cases per 1000 people, with women more likely to display positive antibodies in their serum, adding to the fact that disease prevalence increases with age (Massimo et al., 2020).

The balance between anti-inflammatory and inflammatory immune responses is maintained through immunoregulatory cell populations and immunosuppressive cytokines. Interleukin-35 (IL-35), which belongs to the IL-12 family and is an inhibitory cytokine, is capable of potently suppressing T cell proliferation and inducing IL-35-producing induced regulatory T cells (iTr35) to limit inflammatory responses (Cheng Y et al., 2021). IL-35 is the basis for immunosuppressive and anti-inflammatory activities in various autoimmunity models. Therefore, IL-35 is linked with autoimmune hypothyroidism, especially Hashimoto thyroiditis (Yilmaz et al., 2016). This study was to explain the reversible relationship between decreased levels of interleukin35 and increased pathogenesis in Hashimoto's disease.

Methods

The current study included 90 samples. 60 hypothyroid HT patients (Group 1) and 30 healthy controls (Group 2) were enrolled in the study.

Sample treatment

Taken Ten milliliters (ml) of venous blood were collected from patients as well as controls. The aspirated blood was immediately transferred into a SSGT tube (a serum-separating gel tube) and allowed for 30 min. to clot at room temperature. The sample was centrifuged for 15 min. at 300 rpm (rotation per minute), and the serum was separated into four Eppendorf tubes and stored at -20 °C for investigation for the free triiodothyronine Ft3, free tetraiodothyroxine Ft4, thyroid stimulating hormone TSH, anti-TPOAb, anti-TPOAb, anti-TG Ab, anti-TSHR Ab, and IL-35 test.

Diagnosis of HT

The diagnosis of HT was based on the presence of serum antibodies against thyroid antigens (mainly thyroperoxidase TPO and thyroglobulin TG). Hypothyroidism was defined as elevated serum concentrations of thyroid stimulating hormone (TSH = 0.25–5 μ IU/ml) and normal serum concentrations of free thyroxine (FT4) and triiodothyronine (FT3). The control group was made healthy individuals who were not found to have any chronic diseases and, upon examination, had no clinical or family history of thyroid diseases. Serum TSH, FT4, and FT3 were evaluated using VIDAS® Bio-Mérieux-France, and levels TPOAb and TgAb were evaluated using Cobass Roche Diagnostics-Mannheim-Germany. Serum levels of IL-35 were estimated by ELISA.

The blood normal ranges in our laboratory are as follows:

- TSH=0.25 - 5 μ IU/ml
- FT4=10.6 – 19.4 pmol/ml
- FT3=4 – 8.3 pmol/ml
- Anti-Tg:< 115 IU/mL.
- Anti-TPO:< 34 IU/mL.

Statistical analysis

The data analysis was performed with IBM SPSS Statistics (version 22) and involved studying hormonal parameters. statistical analysis used mean±, SE, P-value, percentage, and correlation Pearson test to measurement serum IL-35 levels correlation with TSH, TPO-Ab, and TG-Ab in patient and control groups analyzed of the two groups patients and healthy control. Also, the estimate of P<0.05 is statistically significant.

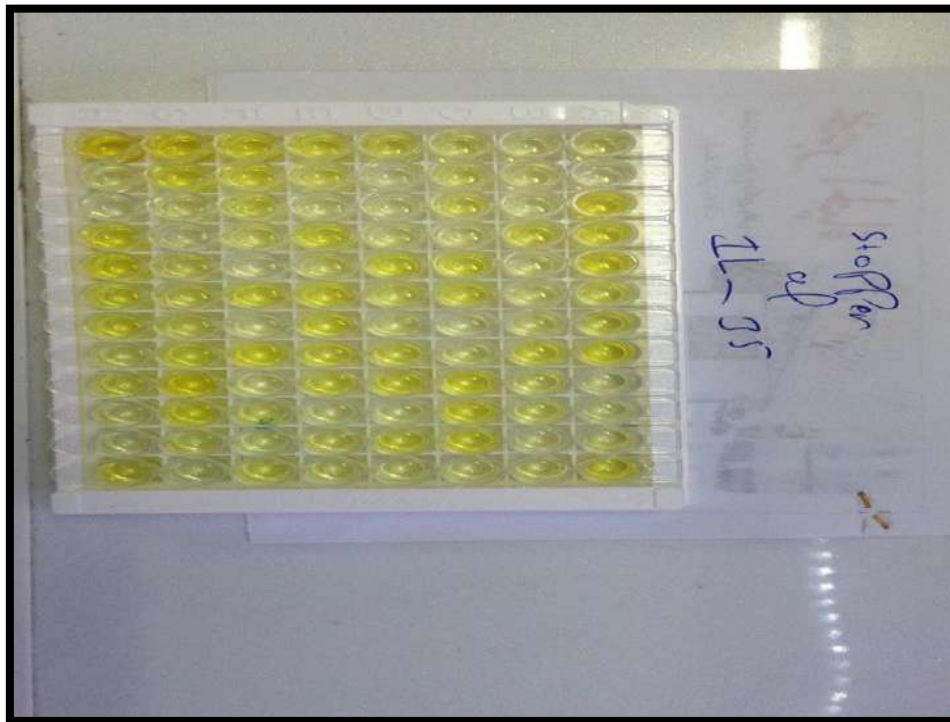


Figure 1. ELISA plate of the detected IL-35 result.

Results

Ninety endocrinology and diabetes patients in Thi-Qar Province, Iraq Who were involved in this study? There were two groups: the first group of patients included 60 (100%) with hypothyroidism. The second group, 30 (100%) healthy control groups, was collected randomly.

Table 1. Distribution of healthy control and hypothyroidism patients with genus

Groups	NO.	%	Genus			
			Females		Males	
			NO.	%	NO.	%
Healthy control	30	100%	22	73%	8	27%
Hypothyroidism	60	100%	53	88%	7	12%
P-value	0.01					

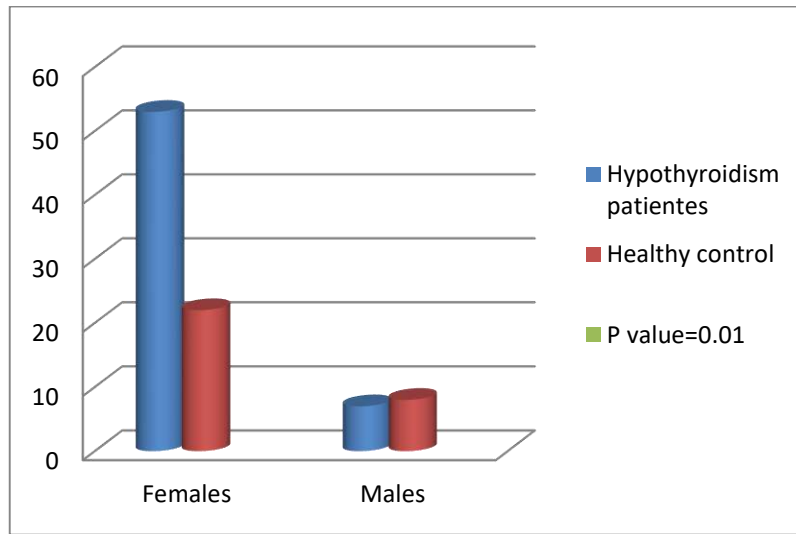


Figure 2. Diffusion of health control and hypothyroidism patient with genus

Table 2. Explain age diffusion of health control and hypothyroidism patients group

Groups	NO.	%	Age - group					
			>30		30-49		49-68	
			NO.	%	NO.	%	NO.	%
Healthy control	30	100%	7	23%	13	43%	10	33%
Hypothyroidism	60	100%	13	21.6%	31	51.6%	16	26.6%
P-value	0.01							

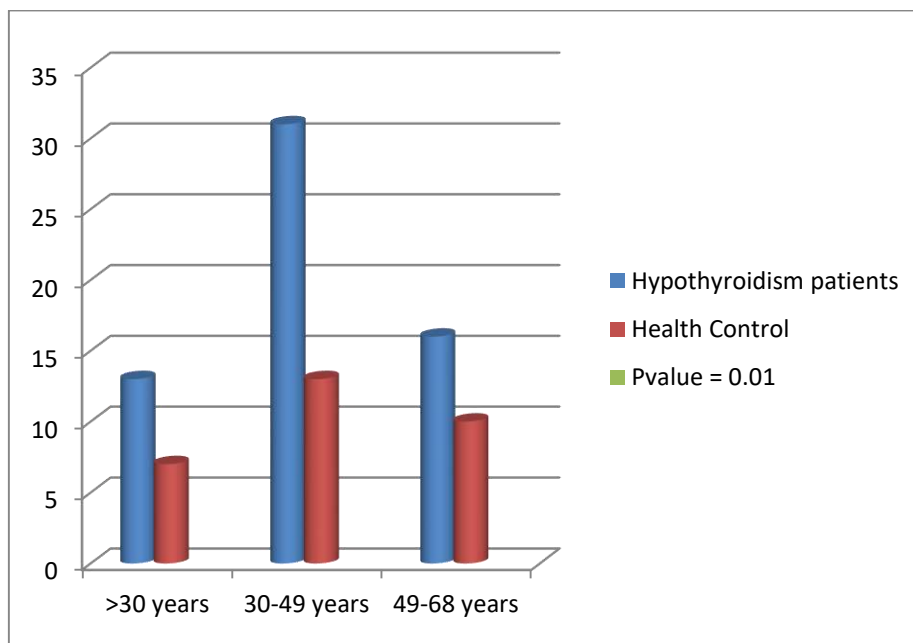


Figure 3. Explain age diffusion of health control and hypothyroidism patients group.

Table 3. Serum TSH, FT4 and FT3 Levels in hypothyroids Patient Groups and Control.

Groups	TSH (uIU/ml)(mean+SE)	FT4 (uIU/ml)(mean+SE)	FT3 (uIU/ml)(mean+SE)
Healthy control	9.22±1.38	10.21±0.503	4.51 ±0.46
Hypothyroidism	20.24± 1.013	7.64 ±0.76	3.94 ±0.35
P-value	0.01		

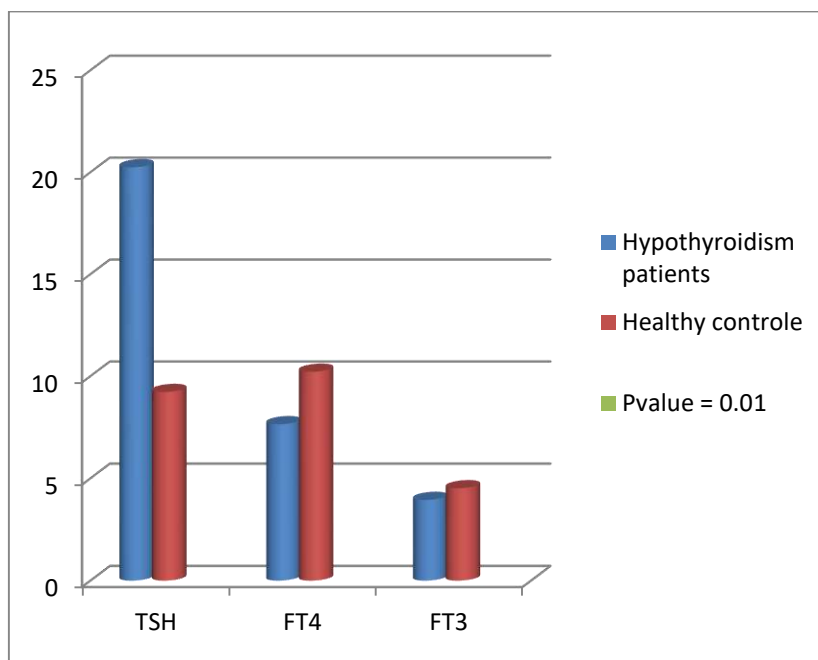


Figure 4. Serum TSH, FT4 and FT3 Levels in hypothyroids Patient Groups and Control.

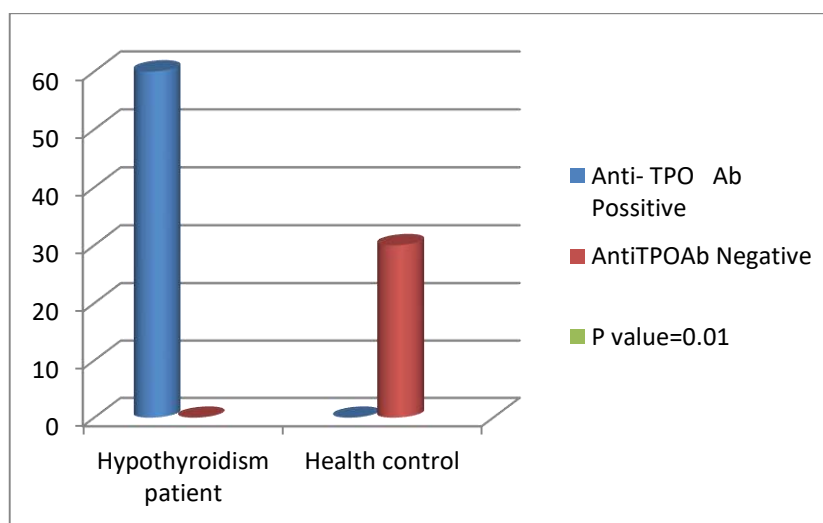


Figure 5. Relationship Between Anti-TPO Abs and Thyroid Disorders Patients.

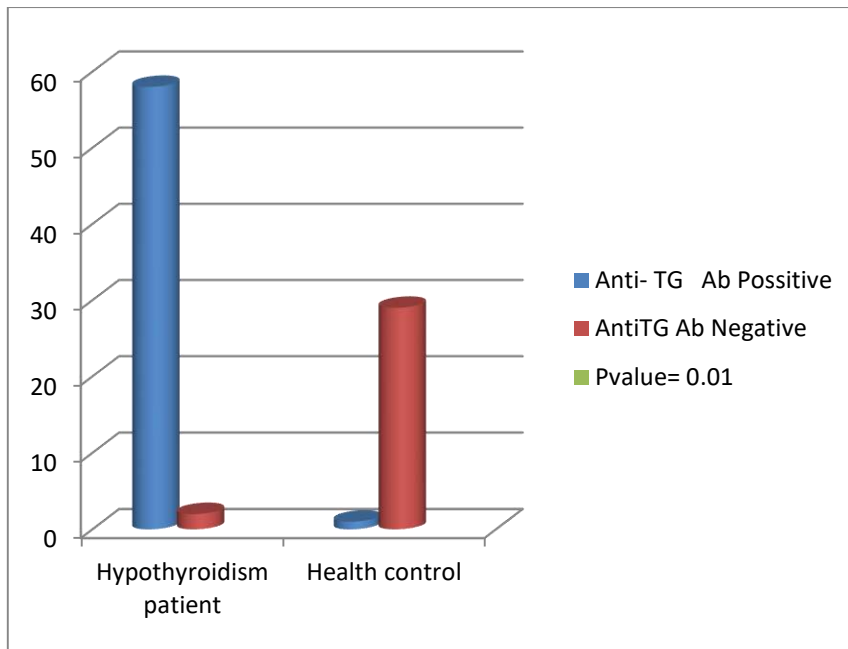


Figure 6. Relationship Between Anti-TG Abs and Thyroid Disorders Patients.

Table 4. serum IL-35 levels Correlation with TSH, TPO-Ab and TG-Ab in Patient and Control Groups

Groups	NO.	Correlation	P-value	Correlation	P-value	Correlation	P-value
		Pearson TSH&IN-35		TG&IN-35		TPO&IN-35	
Healthy control	30	.151	0.04	.192	0.05	.097	0.01
Hypothyroidism	60	-.292	0.03	-.245	0.05	-.269	0.02

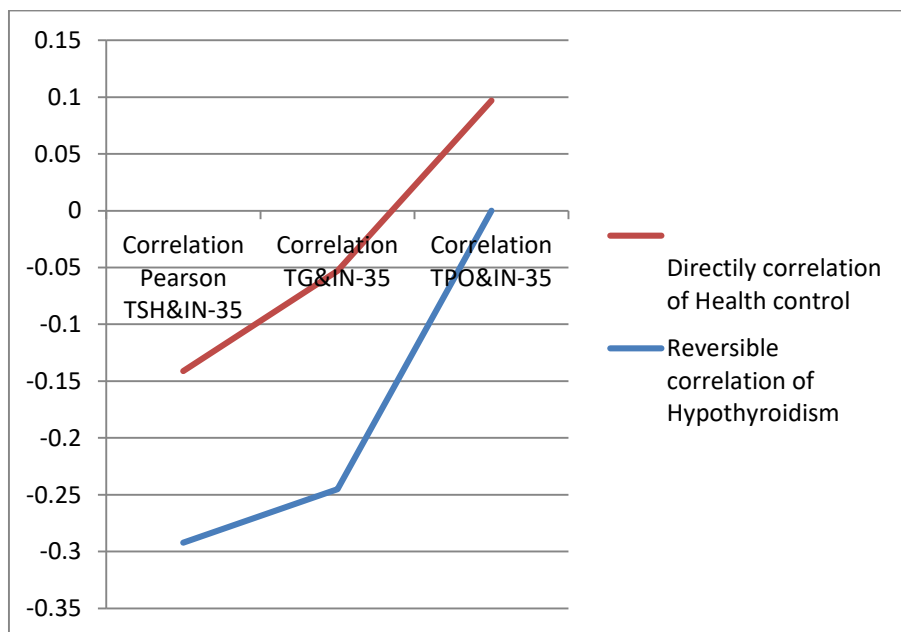


Figure 7. Serum IL-35 levels Correlation with TSH, TPO-Ab and TG-Ab in Patient and Control Groups.

Discussion

The term Hashimoto thyroiditis refers to autoimmune thyroiditis in general, representing several different antibodies (thyroglobulin (Tg) and thyroid peroxidase (TPO) antibodies) that damage your thyroid gland. These antibodies cause inflammation in your thyroid gland .

In some regions of the world, hypothyroidism is caused by a lack of iodine-sufficient iodine. Hashimoto thyroiditis is one of the prevalent typically thyroid autoimmunity diseases, The present study, Table 1 explains that the majority of groups with hypothyroidism have women elevated, 53(88%) and controlled 22(73%) groups.

While the range of hypothyroidism in men has the lowest 8(27%) and controlled 7(12%) groups. According to the genus of the patient and health control included in the study, used statistical test percentages and $P \geq 0.01$ showed that there were significant differences between controlled and hypothyroidism. The reason behind this gender comparison has to do with female bodies being more sensitive to hormonal changes than male bodies. Pregnancy is also associated with changes in thyroid function in pre- and postmenopausal women.

Hypothyroidism is more diffuse in women, who have a 4–10fold greater likelihood of developing it than men (Stagnaro-Green et al., 2011). Hypothyroidism can exist at birth, and the woman is more exposed to complications in the thyroid system because of iodine deficiency. also Stress causes a spike in TSH hormone release (Glenn D et al., 2022). Also, increased estrogen can lead to an enlarged thyroid (goiter).

Explain, American Thyroid Association, 2021, that estrogen plays a critical role in regulating the protein that binds to the thyroid hormone (TBG). And The distributions of those patients and a healthy control group according to age Collectively, ages ranged between 12 and 68) years. The age of subjects was allocated into three groups: less than 30 (group one), 30to 49 (group two), and 49 to 68years(group three). It can be observed from the table (using percentages and ($P \geq 0.01$) that the opportunity for hypothyroidism increases with age.

The highest occurrence of hypothyroidism was recorded in the ages between (30- 49) years which are distributed as 31(51.6%) ,13(43%) in the patient and controlled groups, respectively. Genus between (49-68) years, diffusion as 16(26.6%) and 10 (33%) in the patient and controlled groups, respectively.

While the patients were recorded in genus low than 30 years, which are distributed as 13 (21.6%) ,7(23%)in the patient and controlled groups . Because hypothyroidism is more common in older persons, principally due to the rising incidence and prevalence of Hashimoto thyroiditis, Furthermore, the incidence of hypothyroidism fixedly increases with advancing age. Estimates of the

prevalence of hypothyroidism among the elderly have varied depending on the populations studied and the criteria used to define the condition. (Surks MI et al., 2007).

According to the American Thyroid Association, 2021, extensive statistics show that age-related incidence of hypothyroidism can be reputation to various environmental and genetic factors, including pregnancy, Hashimoto thyroiditis, medication, childbirth, hormonal changes, and radiation exposure.

Hypothyroidism refers to a state in which the serum TSH concentration is high but the serum T4 and triiodothyronine (T3) concentrations remain normal, and hypothyroidism is prevalent in various populations, especially in older females.

Serum TSH, FT4, and FT3 levels for hypothyroid patients and control groups are presented in Tables (3), TSH level significantly ($P \geq 0.01$) increased ($20.24 \pm 1.013 \mu\text{IU/ml}$) in the hypothyroid group, while in the other groups, despite that, the TSH level was very low ($9.22 \pm 1.38 \mu\text{IU/ml}$) in the healthy group, respectively. Normal FT4 levels ($10.21 \pm 0.503 \text{nmol/l}$) and (7.64nmol/l) were noticed in hypothyroidism and healthy control groups, respectively.

Also, there was a FT3 level ($4.51 \pm 0.46 \text{nmol/l}$) and (3.94nmol/l) in the hypothyroidism and healthy control groups, respectively. The serum TSH concentration is increased, but the serum free T4 and triiodothyronine (T3) concentrations remain normal.

This diagnosis is hypothyroidism. As observed in Hashimoto's, TPO-Ab seems to be involved in the tissue-destructive processes associated with hypothyroidism (Schiefer & Fatourechi, 2008). The relationship between anti-TPO antibodies and anti-TG antibodies in Hashimoto's thyroid disorder was very evaluative (Ayaz et al., 2014).

As shown in Table (4), serum IL-35 levels were inversely correlated with TSH, TPO, and TG in patients Hashimoto thyroiditis.

While serum Interleukin35 levels were directly correlated with Thyroid stimulating hormone, TPOAb and TGAb in healthy controls, IL-35 is an anti-inflammatory immune response that plays a essential role in the inhibited of autoimmunity diseases.

When loss of self-tolerance occurs, this causes the absence of balanced anti-inflammatory immune responses, which reduces the in vivo suppressive capacity of Treg, which is essential role in autoimmune disease, especially Hashimoto's thyroiditis (HT), and IL-35 may play a role in the inflammatory nature of HT.

Because of the inverse relation between interleukin 35 level and TSH, Thyroid peroxidase antibody and TGAb, this helps thyroid cell apoptosis and follicular destruction, resulting in leaks in lymphocytic to thyroid and diffuse autoantibodies (Yilmaz et al., 2016). In conclusion, Our findings

indicate an effective role for interleukin 35 in the reverse association with auto-antibodies and the development of autoimmune diseases, especially Hashimoto's disease and its severity.

In the future, we will need much research to explain the relationship between loss of tolerability and autoimmune disorders.

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Frequency of Genes Mediated β -lactams Resistance in *Acinetobacter Baumannii* Isolates from Iraq

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Elhassan Benyagoub ²



Abstract

Background: *Acinetobacter baumannii* is a nosocomial virulent microorganism that can cause acute and chronic infections in burn patients.

The aim of the study: Diagnosis of genes mediated β -lactams resistance among test isolates.


Materials and Methods: 649 swabs collected from inpatients with burn-wound infections at a burn center in Al-Najaf Province/ Iraq, from August 2022 to February 2023.


Results: 68/ 649 (10.5%) isolates of *Acinetobacter baumannii* were identified according to microscopically, cultural, and biochemical features. 22 (32.4%) isolates were found able to produce extended-spectrum β -lactamases by using the double disks synergy method, and these producers tested by polymerase chain reactions technique for molecular determination β -lactams resistance encoding genes. This technique determined that the frequency of a single *bla*TEM gene and a single *bla*CTXM gene was 3/ 22 (13.6%) for each one among the test isolates and that 9/ 22 (41%) isolates possessed linked genes: the *bla*CTXM and *bla*TEM genes, whereas the *bla*SHV gene was not identified in any test isolate.

Conclusions: The co-associated (*bla*TEM and *bla*CTXM) genes were revealed to be prevalent among the test isolates.

Key Words *Acinetobacter baumannii* ; Burn wound infections ; ESBLs ; PCR ; *bla*TEM ; *bla*CTXM ; *bla*SHV

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Introduction

Acinetobacter baumannii is a bacterium that can cause various infections including secondary infections of burn patients, bacteremia, ventilator-associated pneumonia, and meningitis. Recently, these pathogens have been classified as a “red alert” human-pathogens, raising concerns in medical institutions due to their widespread resistance to antimicrobials. *A. baumannii* was widely thought to be sensitive to a range of antibiotic agents, but it has shown broad resistance to most first-line antibiotics. This pathogen has gained notoriety in conflict environments such as the desert environment of Iraq, hence the name "Iraqibacter". This reputation comes from the isolation of highly virulent-strains (HVS) of *A. baumannii* known to be resistant to multiple antibiotics from US Army soldiers with high cases of bacteremia after the Iraq liberation campaigns in 2003, which increased the interest of scientific institutions in this pathogen and led to great progress in understanding its characteristics [1, 2, 3]. The importance of this pathogen is due to its capacity to regulate or gain various resistance factors, which qualifies to be a successful multidrug-resistant (MDR) pathogen that threatens antibiotic treatment [4]. Diverse and challenging resistance mechanisms in *A. baumannii* are well known, with potencies of main classes of antibiotic agents at lower levels via a wide range of antibiotic target mutations, impermeability, changes in efflux pumps, and antibiotics-hydrolyzing enzymes. This pathogen has the unique property of maintaining an MDR phenotype, which threatens treatment success. There is widespread controversy about the virulence of *A. baumannii* diseases, with associated death rate ranging from 8%-35%, based on the type and virulence of the strains. The difference in mortality rates may be due to virulence determinants and the expression levels of these factors. *A. baumannii* has acquired resistance to many antibiotics by acquiring resistance genes by horizontal transfer of genes. Investigations have shown that the critical factor in the success of this pathogen as a nosocomial agent is the acquisition of the MDR phenotype [5]. Although the third generation of cephalosporins has been developed to combat MDR strains, unfortunately, plasmids have been reported carrying genes encoding β -lactamases belonging to the CTXM, SHV, or TEM families, which can hydrolyze extended-spectrum β -lactamase (ESBL) [6]. Even though international studies have recently indicated a high prevalence of the production of ESBL enzymes in *A. baumannii* isolates, local studies are rare and limited to a very narrow scope. Therefore, the target of the present study was to draw a genetic map of the genes that code for the production of ESBLs in local isolates.

MATERIALS AND METHODS

1. *Acinetobacter baumannii* Identification

Swabs collected from 649 inpatients with burn-wound infections at a burn center in Al-Najaf Province/ Iraq, from August 2022 to February 2023. According to laboratory identification steps, 68/ 649 (10.5%) isolates were identified as *A. baumannii* [7].

2. Phenotypic Detection of ESBLs Production

Double Discs Synergy Test (DDST)

A bacterial inoculum was prepared for each test isolate based on the Kirby-Bauer method [8], and then the suspension of test isolate was distributed on Mueller Hinton agar (MHA) (Oxoid-UK) using the streaking method. The amoxicillin/clavulanate disc, 30µg was centered on MHA and four discs: (ceftazidime-30µg), (ceftriaxone-10µg), (cefotaxime-30µg), and (aztreonam-30µg) (HiMedia-India) were placed around it. A distance of 1.5 cm was left from the centers of the four discs to the center of the amoxicillin/clavulanate disc, and then the streaked plate of MHA was incubated aerobically overnight at (37±2°C) [9].

3. Genotypic Detection of ESBLs Production

Three primers were chosen for amplification fragments of 585 bp (*bla_{CTXM}*), 931 bp (*bla_{TEM}*), and 868 bp (*bla_{SHV}*). The primer pairs were: *bla_{CTXM}*-F-5'CGA TGTGCAGTACCAGTAA3' [10]/ R-5'TTAGTGACCAGAATAAGCGG3'; *bla_{TEM}*-F5'ATGAGTATTCAACATTTCCG3'/ R-5'CCAATGCTTAATCAGTGAGC3'; *bla_{SHV}*-F-5'CTTTACTCGCTTATCG3'/ R-5'CCAATGCTTAATCAGTGAGC3' [11].

Ethical Considerations: The study was approved by the Burn Center in Najaf Governorate/Iraq. Patients were asked for permission before taking samples, and the medical staff supervised the collection of swabs from inpatients.

Statistical Analysis: The statistical software (SPSS-v24.0) was used to manage the data of the present study.

RESULTS

Isolation and Detection *Acinetobacter baumannii* Isolates

According to microscopic, cultural, and biochemical characteristics, out of the 649 swabs, 203 (31.3%) isolates were identified as Gram-positive bacteria, 341 (52.5%) as Gram-negative bacteria, and 68 (10.5%) isolates were identified as *A. baumannii*. While 37 (5.7%) swabs showed no growth [Figure 1].

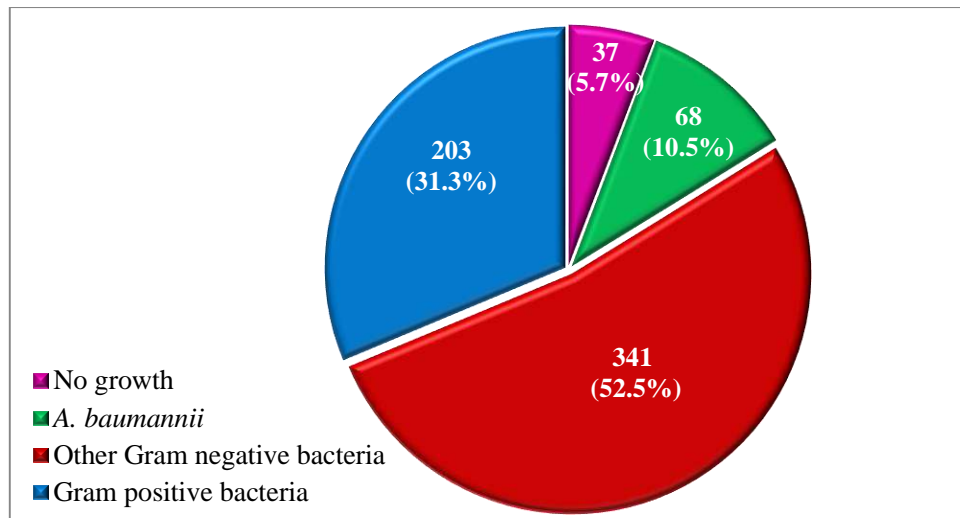


Figure 1. Percentages of bacteria isolated from patients with infected burn wounds

Detection of β -lactams Resistance in *Acinetobacter baumannii* Isolates

Twenty-two (32.4%) isolates were found able to produce ESBLs by using DDST, and these producers were subjected to PCR technique for molecular detection of β -lactams resistance encoding genes. This technique identified that 15 isolates (22.1%) out of 68 *A. baumannii* isolates were carriers of diverse patterns of ESBLs encoding genes, as follows: 3/ 22 (13.6%) isolates harbored single *bla*_{TEM} gene, 3/ 22 (13.6%) isolates carried single *bla*_{CTXM} gene, while 9/ 22 (41%) had *bla*_{TEM} and *bla*_{CTXM} genes together. But *bla*_{SHV} gene wasn't detected in any isolates under study [Tables 1, 2, and 3] and [Figure 2].

Table 1. Detection of ESBLs production by phenotypic and genetic methods in 68 isolates of *A. baumannii*

Method	ESBLs ^{+ve} n (%)	ESBLs ^{-ve} n (%)
Phenotypic	22 (32.4)	46 (67.6)
Genotypic	15 (22.1)	53 (77.9)

Table 2. Frequency of genes encoding the production of ESBLs in *A. baumannii*

Genes type	No. of genes N= 15/ 22 (68.2%) n (%)	Type of genetic association	Frequency of gene association N= 15/ 22 (68.2%) n (%)
<i>bla</i> _{TEM}	3 (13.6)	Single	6 (27.2)
<i>bla</i> _{SHV}	0 (0.0)	Non	
<i>bla</i> _{CTXM}	3 (13.6)	Single	
<i>bla</i> _{TEM} + <i>bla</i> _{CTXM}	9 (41)	Multiple	9 (41)

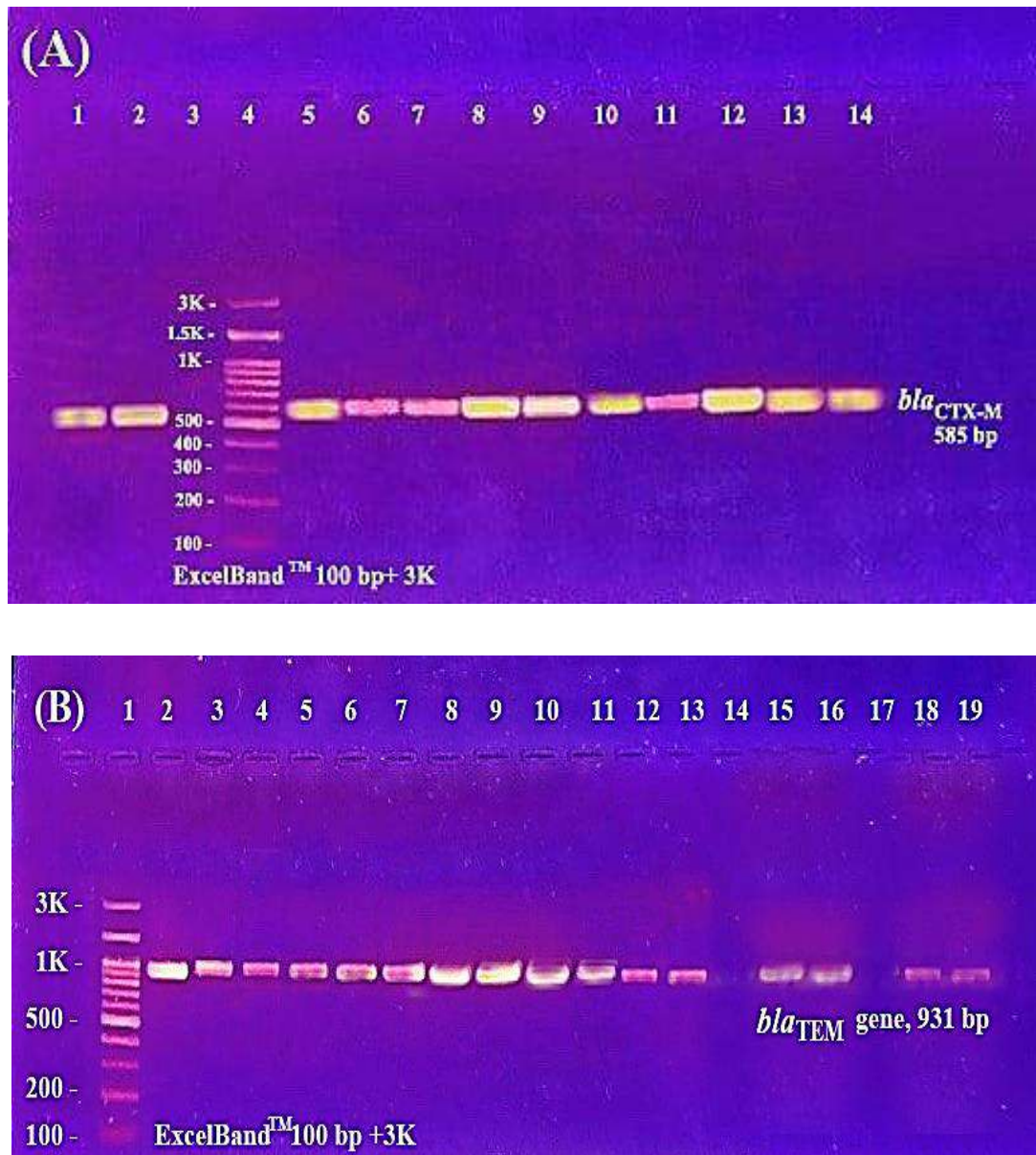


Figure 2. Revealing of ESBLs-encoding genes in *A. baumannii* using PCR technique

Electrophoresis was used to separate the PCR products on an agarose gel weighing 0.750 g. For 1.5 hours, 70 Volts were used to conduct the electrophoresis. (A): lane 1-2 and 5-14: positive *bla*_{CTXM} gene, lane 4: ladder; (B): lane 1: ladder, lane 2-13, 15-16, 18-19: positive *bla*_{TEM} gene.

Table 3. The genotype patterns of 22 *A. baumannii* isolates that were phenotypically identified as ESBLs-producers

Isolate code	Phenotypic ESBLs Detection N= 22	Sex [Male (M) and Female (F)] and age	ESBLs encoding genes			No. Number of genetic patterns for ESBLs 15/ 22 (68.2%) n (%)
			<i>bla</i> _{TEM}	<i>bla</i> _{CTXM}	<i>bla</i> _{SHV}	
2	+	M, 46	+	+	-	1 (4.5)
5	+	M, 48	+	+	-	1 (4.5)
9	+	M, 39	+	+	-	1 (4.5)
10	+	M, 67	-	+	-	1 (4.5)
11	+	M, 56	+	+	-	1 (4.5)
23	+	F, 48	+	+	-	1 (4.5)
24	+	F, 68	-	+	-	1 (4.5)
26	+	M, 63	-	-	-	0.0
42	+	M, 54	-	-	-	0.0
46	+	M, 77	-	-	-	0.0
47	+	M, 66	-	-	-	0.0
48	+	F, 59	+	+	-	1 (4.5)
50	+	F, 55	+	-	-	1 (4.5)
52	+	F, 68	-	+	-	1 (4.5)
54	+	F, 36	+	+	-	1 (4.5)
63	+	M, 28	+	+	-	1 (4.5)
64	+	M, 71	-	-	-	0.0
67	+	F, 79	+	-	-	1 (4.5)
69	+	M, 53	-	-	-	0.0
77	+	M, 44	-	-	-	0.0
83	+	F, 57	+	-	-	1 (4.5)
88	+	M, 52	+	+	-	1 (4.5)

Demographics of patients with wound infections caused by ESBLs- producers

It was noted in the present investigation that the ESBLs-producing *A. baumannii* isolates identified by the phenotypic method had a higher frequency in males 14 (63.6%) than in females 8 (36.4%). Interestingly, a high percentage of 7 (31.8) ESBLs-producers in the age group (40-50) followed by a percentage of 5 (22.7%) in the age group (50-60) [Table 4].

Table 4. Demographics of inpatients with burn wound infections caused by 22 ESBLs-producing *A. baumannii* isolates

Patient profile	Age group (10-80) years	ESBLs-producers among both sex (N= 22)		Total N= 22 n (%)	P-value
		Female 8 (36.4%) n (%)	Male 14 (63.6%) n (%)		
Age group year	20-	0 (0.0)	1 (7.1)	1 (4.6)	NS
	30-	1 (12.5)	1 (7.1)	2 (9.1)	<0.077
	40-	3 (37.5)	4 (28.6)	7 (31.8)	<0.0001*
	50-	2 (25.0)	3 (21.4)	5 (22.7)	<0.0002*
	60-	1 (12.5)	3 (21.4)	4 (18.2)	<0.076
	70-80	1 (12.5)	2 (14.4)	3 (13.6)	<0.068

NS, non significant. *signefecant at $p < 0.05$.

DISCUSSION

Over recent years, *A. baumannii* has been well-known to resist β -lactams via activation of efflux pumps, penicillin-binding proteins production, and production of different classes of β -lactamases [12]. Resistance to β -lactams by these pathogens was primarily found to be caused by the production of β -lactamase enzymes that included carbapenemases, oxacillinases, and ESBLs [13].

Since the production of ESBLs was the most widespread phenomenon globally among strains of nosocomial *A. baumannii*, the main focus of the current investigation was on the molecular aspect responsible for encoding the production of ESBLs and contributing to their spread locally. In this study, the ESBLs-producing isolates identified by phenotypic methods were 22 (32.4%), while the ESBLs-producers identified molecularly were 15 (22.1%). It was expected and intuitive that there would be a difference between phenotypic and molecular identification of ESBLs-producers because molecular methods depend on selected primers to identify specific genes, which reduces the possibility of diagnosing other genes that may be producing ESBLs. There is also the possibility of the existence of ESBLs-encoding genes that have not been discovered or perhaps it will be covered up in the future. All of these and other reasons make phenotypic methods practical for diagnostic and routine purposes, but they are not the ideal method for ESBLs-genetic identification. In general, phenotypic methods provide a predictive step for isolates carrying genes encoding ESBLs, and they also reduce the number of isolates that are subjected to molecular assay. The complexity of molecular methods prompts researchers to use phenotypic methods to reduce time, effort and cost in sorting positive and negative ESBLs-isolates [14, 15].

One of the interesting results in the present investigation regarding the isolation percentage of *A. baumannii* by gender and age, it was noted that the prevalence of the pathogen among males is higher than among females, specifically in the age groups (41-51) and (51-61) years. This is an indication that males are more affected by *A. baumannii* infections, especially in the active age groups. These findings agree with the results of many reports, and the study prepared by Ahmed et al [16] explained the reasons for the exposure of males in active age groups to *A. baumannii* infections because males work outside the home for long periods, which increases the possibility of their exposure to infection with these pathogens. The reasons for males being infected with *A. baumannii* bacteria more than females are due to the hormonal difference between the sexes. Studies have found that high concentrations of testosterone in males have an inhibitory effect on the immune system and immune response [17]. Hadi et al [18] found that the difference in response to bacterial infections was due to differences in pharmacodynamics, pharmacokinetics, and differences in biological processes, and may be attributable to other factors such as social and cultural differences. A Chinese study found that infections caused by ESBLs-producing *A. baumannii* were significantly more dominant among male patients than female patients, regardless of the origin of the sample [19]. Bshabshe et al [20] found that (63.81%) of the patients were males, while the percentage of females was (36.19%), and was also found that the age group over 60 years was influenced by *Acinetobacter* species (47.62%). Yadav et al [21] also found that the isolation rate of MDR- *A. baumannii* was 58.3% higher in males than in females, which was 41.7%. Many studies have indicated that the distribution and spread of ESBL-producing *A. baumannii* varies among regions of the world. The prevalence rate of this pathogen globally was affected by various factors such as the age of patients and their immune response, the severity of the infection, methods for determining pathogens, the length of stay for hospitalization, therapeutic methods, and the widespread use of antibiotics in many preventive and therapeutic fields [22]. Antunes et al [23] and Alyamani et al [6] emphasized that the true causes of ESBLs are not specifically known, and there is a wide possibility that they are underestimated as a result of the difficulties and lack of capabilities in most local hospitals in discovering them. However, it is clear that producers of ESBLs are widespread throughout the world and that the prevalence of these strains is increasing. In order to detect the most important findings of the molecular identification of the genes encoding resistance to β -lactam antibiotics in the present investigation, this study revealed the prevalence of *bla*_{TEM} + *bla*_{CTXM} associative genotype in the local *A. baumannii* more than other genes. It was also observed that the *bla*_{TEM} and *bla*_{CTXM} genes were equal in number and relatedness in the ESBLs-producers under study. In Iraq, it appears that the universal *bla* genes encoding ESBLs production are common in *A. baumannii* strains, as it was found that the prevalence of (*bla*_{SHV}+*bla*_{TEM}) genes was 25% and 8.8%, respectively [24]. In another study, it was recorded that 45% and 75% of *A. baumannii* test isolates possess the *bla*_{CTXM} and *bla*_{TEM} genes, respectively [25].

In countries neighboring Iraq, such as Iran, the prevalence of the *bla*_{CTXM} and *bla*_{TEM} genes among ESBLs-producers have been observed in 43.4% and 52.1%, respectively [26]. In another study from Iran, 7.9% and 20% of the tested *A. baumannii* isolates were identified as carrying the *bla*_{CTXM} and *bla*_{TEM-1} genes, respectively [22]. In Turkey, the frequency of the *bla*_{TEM} gene was found more common and dominant, while it was found that the *bla*_{SHV} gene was not the most influential gene among ESBLs-producers [27]. In contrast to the current study, a Saudi study recorded that 58% of the ESBLs-producers were carriers of the *bla*_{SHV} gene 20% of these isolates were carriers of *bla*_{CTXM} and no isolates were found to carry the *bla*_{TEM} gene [11]. In Saudi Arabia, the *bla*_{CTXM} (97.4%) gene was detected more frequently than the *bla*_{SHV} (23%) gene, whereas the *bla*_{TEM} gene was not identified at all [28]. β -lactamase type CTXM produced by strains of *A. baumannii* are plasmid-mediated and thus spread widely and survive for a long time in hospitals. The *bla*_{CTXM} gene prevalence is affected by transportable genetic factors such as: classes of integrons, transposons, different types of plasmids, and. β -lactamases encoding genes are easily transmitted through extrachromosomal elements and plasmids increasing resistance to β -lactams and reducing treatment choices against serious infections caused by Gram-negative [29]. The genes encoding the production of ESBLs are often carried on transfer plasmids between bacterial genera and species, in addition to having the ability to integrate genetic elements coding for resistance to other antibiotics, which leads to increased virulence of the pathogen and the possibility of treatment failure [30]. Infections caused by (ESBLs-producers) face increasing therapeutic limitations. In addition to the increased risk of patients suffering from infections with these strains being exposed to the possibility of treatment failure, increased stay of patients in hospital for hospitalization, high costs of long-term care and treatment, and an expected increase in mortality rates [31]. Consistent with this research, most CTXM enzyme-producing Gram-negative bacteria are frequently related to other bacterial genera resistant to other β -lactamases causing MDR. The *bla*_{CTXM} gene has been shown globally to be involved in conferring acquired virulence traits on Gram-negative bacteria such as resistance to β -lactams and MDR [6]. In the past decades, SHV and TEM variants appeared to be among the most universal types of ESBLs, but CTXM has recently shown an ability to be more prevalent and dominant than other extended genes [32].

CONCLUSIONS

The frequency of a single *bla*_{TEM} gene was equal to a single *bla*_{CTXM} gene among the tested isolates, while the related genes: *bla*_{CTXM} and *bla*_{TEM} were more dominant, whereas the *bla*_{SHV} gene was not identified in any test isolate. The virulence of local ESBLs-producing *A. baumannii* lies in the fact that they contain genes with global origins, which indicates their ability to spread just like global strains. The increase in the frequency of linked genes is also of concern because the transfer of linked genes indicates the role of MGEs in transferring resistance-coding genes at once, especially in hospital-endemic strains that pose an additional burden on burn patients.

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Effect of *Cocos nucifera* oil on Iraqi strains of *Leishmania in-vitro*

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Amjed Qays Ibrahim Alqaisi ²





Abstract

Leishmaniasis is a disease spread by sand-fly vectors of *Phlebotomus* spp. It is classified as one of the 17 Neglected Tropical Diseases (NTDs) by the World Health Organization (WHO). It is considered a major invasive parasite among immunocompromised individuals. Leishmaniasis presents in various forms, including cutaneous leishmaniasis (CL), visceral leishmaniasis (VL), and mucocutaneous leishmaniasis (MCL). The rate of manifestation is contingent upon the species implicated and the immunological response elicited by the infection. To investigate the impact of different concentrations of Medium-Chain Triglycerides (MCT) oil on the proliferation of promastigotes of *Leishmania tropica* and *Leishmania donovani*, two types of promastigotes were subjected to *in vitro* analysis using chamber counting. During the designated period of incubation, the specimens were subjected to incubation for durations of 24, 48, and 72 hours. The results of this study demonstrated a statistically significant decrease in the survival of promastigotes when compared to the control group. The findings of this study revealed a notable inhibitory effect on the proliferation of *Leishmania tropica* and *Leishmania donovani* promastigotes *in vitro* upon exposure to MCT oil. It is recommended to conduct further investigations on the impact of MCT oil on amastigotes and to carry out *in vivo* studies in future research endeavors.

Key Words *Leishmania* ; MCT ; *in vitro*

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Introduction

Leishmaniasis is a disease that transmitted between animals and humans and is present worldwide. It is recognized as a major public health concern in many nations across the world. As per the World Health Organization (WHO), leishmaniasis is considered endemic in a total of ninety-eight countries, posing a significant risk of infection to around 350 million individuals(1). According to the officially documented data, there have been around 58,000 reported cases of visceral leishmaniasis and 220,000 reported cases of cutaneous leishmaniasis on an annual basis. (2, 3). The primary medical treatments for leishmaniasis encompass the utilization of sodium stibogluconate, an antimony-based medication, and amphotericin B, an antifungal medication. However, these therapies are associated with high costs and undesirable side effects, including abdominal pain, nausea, and anorexia(4, 5).

Regrettably, the therapeutic efficacy of these medications is currently being undermined due to the emergence of clinical resistance in numerous regions worldwide. The emergence of drug resistance has posed a significant challenge in the management of leishmaniasis in certain regions where the disease is prevalent(6). *Leishmania* possesses well-established mechanisms for effectively entering macrophages and is capable of controlling the advancement of phagosomes to facilitate parasite growth and evade elimination(7, 8).

Hence, numerous botanical species have been evaluated for their potential therapeutic applications in the treatment of parasitic ailments(9, 10). Such as the coconut (*Cocos nucifera* L., family Arecaceae), holds significant importance as a fruit tree on a global scale. The primary utilization of copra, which refers to the desiccated kernel, is for the purpose of extracting oil. The oil exhibits a notable abundance of medium-chain fatty acids (MCFA) and advantageous digestibility. Various types of coconut oil are derived from distinct components of the coconut using diverse extraction methods(11, 12). Oil or fat is a chemical combination consisting of triacylglycerol molecules, where glycerol is esterified with three fatty acids. A fatty acid is a type of monocarboxylic acid that consists of an even number of carbon atoms ranging from 4 to 22(13, 14).

There are two types of coconut oil that can be derived from the meat of the coconut tree (*Cocos nucifera*): coconut oil (also known as copra oil) and virgin coconut oil (VCO)(15, 16).

The parts that make up *Cocos nucifera* have many biological effects, such as killing parasites and worms, reducing inflammation and pain, protecting cells from damage, fighting fungal growth, bacteria, and cancer. Previous research has partly confirmed the plant's many uses, such as its ability to relieve pain, fight arthritis, kill bacteria, lower fever, get rid of parasites, stop diarrhea, and lower blood sugar. Furthermore, various other qualities have been observed, including antihypertensive, anti-inflammatory, antimicrobial, cardioprotective, antiseizure, antioxidant, cytotoxicity, vasodilation,

hepatoprotective, nephroprotective, and anti-osteoporosis effects. The pharmacological effects of *Cocos nucifera* change depending on the specific ingredients present in each portion of the plant under evaluation(17, 18).

In some studies, the ovicidal and larvicidal activity of *Cocos nucifera* butanolic and aqueous extracts against *Haemonchus contortus* was assessed, revealing that the butanolic extract exhibited complete ovicidal activity at a rate of 100%. The larvicidal effects of the tested substance were observed to be 81.30% and 99.80% at the concentrations of 65 mg/ml and 80 mg/ml, respectively(19, 20). Several studies have demonstrated the efficacy of husk fiber extract enriched with polyphenolics in exhibiting leishmanicidal activity against both mouse macrophages and promastigotes of the *Leishmania amazonensis* species. The obtained results indicated a minimum inhibitory concentration (MIC) value of 10 µg/ml. Additionally, a significant rise of 182% in the production of nitric oxide was seen in comparison to macrophages that were not subjected to any treatment (21, 22). Furthermore, the finding suggests that the fiber derived from the husk of *Cocos nucifera* has the potential to serve as a therapeutic remedy for leishmaniasis (23, 24).

Materials

1. Preparation of Medium-chain triglycerides (MCT) oil

The medium-chain triglycerides (MCT) oil was acquired from NOW Food, a company based in America. The structural representation of the molecule may be observed in (Figure-1). The stock solution was prepared by dissolving 3 ml of MCT in 97 ml of dimethyl sulfoxide (DMSO), following the guidelines provided by the manufacturer. Various concentrations of MCT were produced from the stock solution, specifically at concentrations of (50, 25, and 12.5) µg/ml.

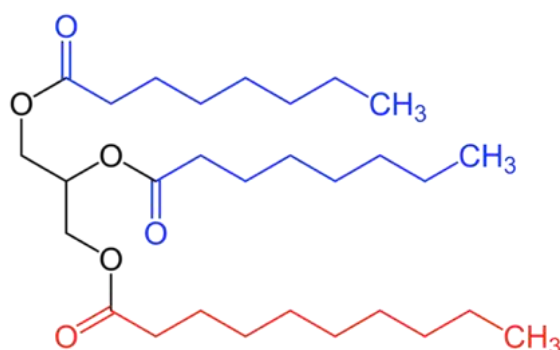


Figure 1. MTC oil structure (25)

2. Cultures of procyclic promastigote for *Leishmania tropica* and *Leishmania donovani*

The *Leishmania tropica* promastigote isolate, which underwent PCR testing in 2016, was donated by the Dep. of Biology/ College of Science/ University of Baghdad(26). The *Leishmania donovani* (MHOM/IQ/2005/MRU15) isolate was obtained from a patient who had been clinically diagnosed with visceral leishmaniasis. This isolate was generously given by the Medical Research Unit of the College of Medicine, Al-Nahrain University (27). The procyclic promastigotes of both strains (*Leishmania tropica* and *Leishmania donovani*) were grown in RPMI-1640 medium (Roswell Park Memorial Institute) (HiMedia Laboratories, India). The medium was made in accordance with the manufacturer's protocol at a pH of 7.4. It was supplemented with 10% heat-inactivated fetal calf serum (HIFCS), 100 IU/ml of penicillin, and 100 µg/ml of streptomycin (pen/strep). The culture of parasites was maintained at a temperature of 26°C for a duration of 48 to 72 hours in order to facilitate the exponential growth of promastigotes(28).

3. Promastigote Proliferation

The investigation of promastigote proliferation involved the direct quantification of cell numbers by growth inhibition analysis. The promastigotes in the stationary phase, at a concentration of 1×10^6 promastigotes/ml, were collected in complete RPMI-1640 medium supplemented with 10% fetal calf serum (FCS) at a temperature of 26°C. Subsequently, 1×10^6 procyclic promastigotes/ml of the parasite were added into 8 universal vials, each containing 2 ml of RPMI-1640 medium. Different concentrations of MCT oil (50, 25, and 12.5) µg/ml were added to the respective test groups. The control group was treated with a compound solvent known as pentostam. The estimation of parasite proliferation involved the quantification of viable motile forms using a Neubauer® chamber at various incubation periods, specifically (24, 48, and 72) hours. The experiment was conducted three times for each test. The quantification of promastigotes was performed using a light microscope and a chamber. The total concentration of procyclic promastigotes per milliliter was determined using the following equation(29):

$$\text{Number of cells} = x = \frac{A+B+C+D}{4} \times 10^4 \times 2 \times \text{sample dilution}$$

A, B, C, D are the 4 squares of chamber.

4. Statistical Data

The Statistical Analysis System (SAS) application, namely the 2018 version, was employed to identify the impact of various factors on the study parameters. The Least Significant Difference (LSD) test, which is a component of the Analysis of Variance (ANOVA), was employed in this study to effectively compare the means(30).

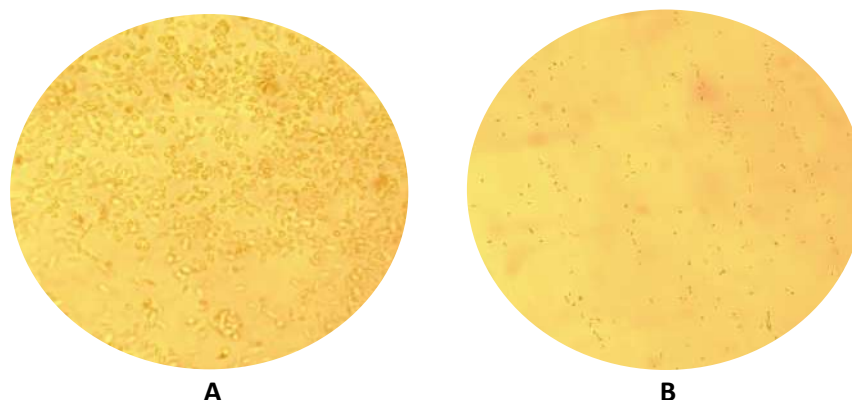


Figure 2. *Leishmania* spp. Procyclic promastigote under light microscope

- A.** Procyclic promastigote culture before treatment (40x)
B. After 48 hours of treatment with MCT oil (10x)

Results and Discussion

The cytotoxicity of MCT oil was evaluated against procyclic promastigotes of *Leishmania tropica* and *Leishmania. donovani* strains from Iraq. The objective was to investigate the impact of MCT oil on the proliferation of procyclic promastigotes in *Leishmania tropica* and *Leishmania donovani*. Microscopic analysis revealed a significant decrease in the overall number of promastigotes over the course of the study, as depicted in Figures 2(A and B).

The findings of the study revealed statistically significant variations ($p \geq 0.05$) in the anti-leishmanial activity between the experimental and control groups for two species, namely promastigote *Leishmania tropica* and *Leishmania. donovani*, at different time intervals (24, 48, and 72) hours. In (25 $\mu\text{g/ml}$) concentration for three periods (24, 48, and 72) hours there was a non-significant difference between treatment groups in the percentage of proliferation for *Leishmania tropica*. While in *Leishmania donovani*, there was no significant difference in the (12.5) $\mu\text{g/ml}$ concentration (Table 1 and 2) and (figure 3 and 4).

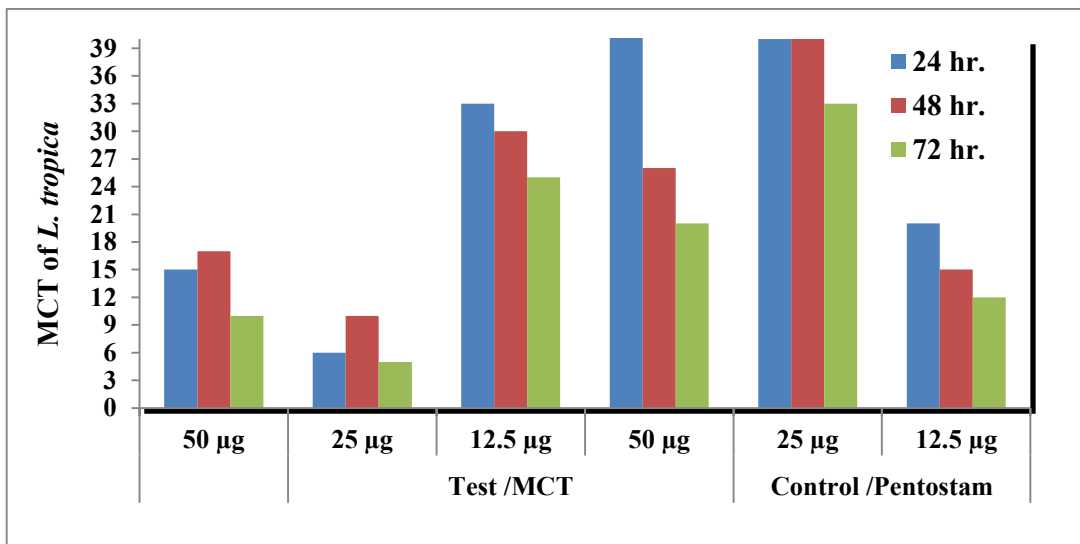
Table 1. Effect of treatment concentration, time in MCT of *Leishmania tropica*

Test /MCT	24h.	48h.	72h.	LSD value
50 μg	15%	17%	10%	5.94 *
25 μg	6%	10%	5%	5.11 NS
12.5 μg	33%	30%	25%	6.74 *
Control/Pentostam	24h.	48h.	72h.	LSD value
50 μg	45%	26%	20%	7.44 *
25 μg	40%	40%	33%	6.72 *
12.5 μg	20%	15%	12%	6.93 *
LSD value	8.72 *	8.37 *	7.66 *	---
* ($P \leq 0.05$).				

Table 2. Effect of treatment concentration, time in MCT of *Leishmania donovani*

Test /MCT	24h.	48h.	72h.	LSD value
50 µg	41%	33%	20%	7.92 *
25 µg	50%	65%	30%	8.22 *
12.5 µg	15%	13%	10%	5.19 NS
Control/Pentostam	24h.	48h.	72h.	LSD value
50 µg	25%	30%	36%	6.58 *
25 µg	20%	28%	40%	8.06 *
12.5 µg	32%	25%	35%	6.17 *
LSD value	7.51	9.46 *	7.91	---
	*		*	

* (P≤0.05).

**Figure 3.** Effect of treatment concentration, time in MCT of *Leishmania tropica*

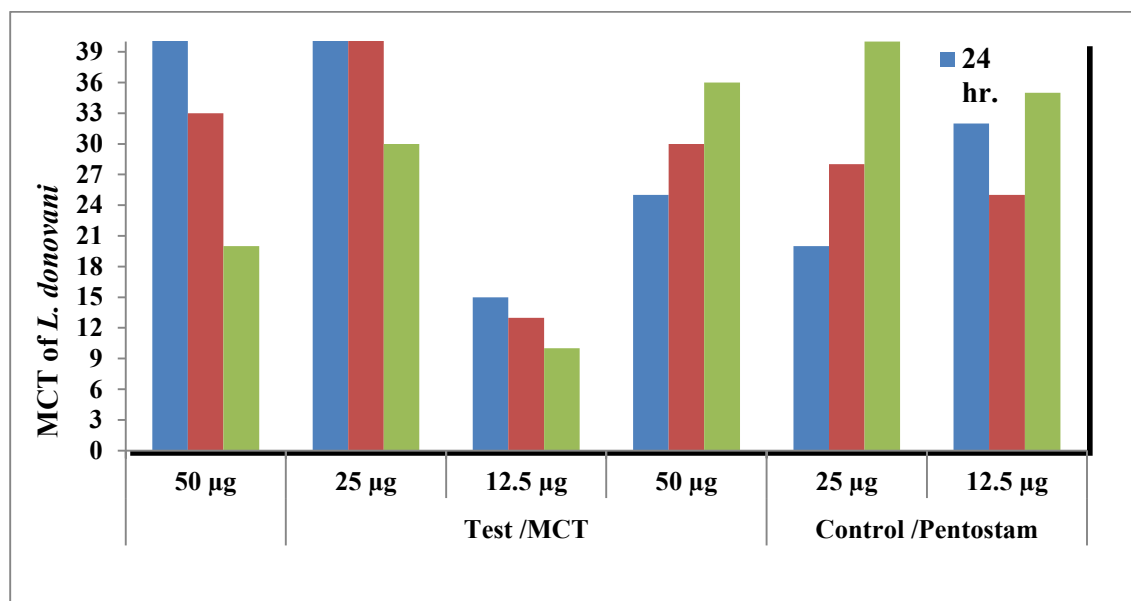


Figure 4. Effect of treatment, concentration, time in MCT of *Leishmania donovani*

The existing therapeutic interventions for leishmaniasis have become largely obsolete due to several drawbacks. These include the inherent variability in drug sensitivity among the seventeen *Leishmania* species that infect humans, the development of resistance to pentavalent drugs in regions with high disease prevalence, and reduced effectiveness in individuals with compromised immune systems, particularly those co-infected with HIV. Additionally, these treatments are associated with serious complications such as cardiotoxicity, pancreatitis, hepatotoxicity, nephrotoxicity, and prolonged hospitalization requirements(31, 32). Therefore, in the present study, the antileishmanial activities of MCT oil were assessed.

Coconut oil is frequently categorized according to its method of production, either as unprocessed (virgin coconut oil, obtained through hot pressing or cold pressing) or as refined. The commonly employed hot (heated to around 40 °C) and cold (at room temperature) methods are frequently utilized for the extraction of oil from freshly harvested and moist coconut (*Cocos nucifera*) fruit (33). The therapeutic properties of *C. nucifera* encompass its utilization as an antiviral agent (34), a hepatoprotective agent (35), an antioxidant, an antibacterial agent (36), a cardioprotective agent, an anti-protozoal agent, and an immunomodulator (21). Bhalla *et. al.* (2017) assessed the leishmanicidal effectiveness of *C. nucifera* extracts, whereby they observed that SSG exhibited inferior healing efficacy in relation to drug-induced toxicity in the treated mice. Therefore, the findings of this research offer valuable insights into the potential of plant-derived medications for the efficacious management of visceral leishmaniasis while minimizing adverse effects (37).

According to Tayler *et. al.* (2019) study on *C. nucifera*, the leaf had a moderate amount of efficacy against the *Plasmodium falciparum* parasite when they tested the husk, pulp, leaves, and milk on parasites and a breast cancer cell line. Contrary to the results in the literature, the husk in our hands

exhibits very little activity. The two coconut plantations' different environmental conditions might be to blame for this difference because they might have produced different metabolites. The leaves of *Cocos nucifera* from Punta Patio demonstrated a little anti *Plasmodium falciparum* action that called for further study(38, 39). Furthermore, coconut oil is a naturally occurring substance that has notable anti-Cryptosporidium properties and shows potential for reducing the occurrence of dysplastic alterations in cases of chronic cryptosporidiosis(40, 41). Also, in another study for the development of natural therapies from coconut oil extracts, which were found to have potential therapeutic efficacy against Cryptosporidiosis(42). This aligns with studies that have demonstrated the anti-parasitic effects of coconut oil against *Leishmania* spp., *P. falciparum*, and *P. berghei* (43, 44).

Regarding the dietary impact of MCT oil on immune function, current research has demonstrated that MCT oil stimulate human neutrophils. This is evident from their impacts on respiratory burst(45), expression of adhesion and degranulation markers(46), as well as functional consequences like migration(47) and phagocytosis(48).

Further research investigated the antiparasitic and anticancer properties of some constituents derived from the coconut plant. We have demonstrated that a concentration of 10 µg/ml of a leaf extract consisting of a 2:1 ratio of dichloromethane to methanol can selectively hinder the proliferation of the parasite responsible for the most lethal variant of human malaria, *P. falciparum*, to a minimum of 50% compared to the control group(38, 49).

The conventional application of *C. nucifera* for treating gastrointestinal parasites and the identification of condensed tannins in the ethyl acetate extract of liquid from green coconut husk fiber (LGCHF) observed in laboratory animals provide a valid basis for evaluating the extract's anthelmintic activity in live subjects. If the ethyl acetate extract derived from LGCHF has shown no efficacy against sheep gastrointestinal nematodes(50, 51).

Conclusion

MCT oil showed an effective leishmanicidal activity against the two forms of the Iraqi strain of *Leishmania tropica* and *Leishmania donovani*, for *in vitro* promastigotes.

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Studying the effect of some natural materials on the germination and growth of chickpea plant (*Cicer arietinum* L.)

Haifaa Abass Hussein ¹




Abstract

A laboratory experiment was carried out in one of the laboratories of the horticulture department, college of agriculture, Al-qadisiya university, during the spring season of the year 2023, with the aim using environmentally friendly natural materials instead of chemical fertilizers and studying their effect as fertilizer for chickpea plant (*Cicer arietinum* L.). A complete randomized design (CRD) was used with three replications and one factor, as the treatments included (T1 control distilled water, T2 banana peels fertilizer, T3 eggs shell fertilizer and T4 mixture of two fertilizers). Results showed that the treatment of the plant with mixture natural fertilizer gave a good result compared to the control treatment 100%, while it gave the lowest germination rate when the control treatment 91.6% without significant differences. The results were also the highest in the number of branching of the root of the seedling and in the same treatment 18.6 branch, while the comparison treatment gave the lowest number of branch and reached 14.3 branch without significant differences. The length of the root stock and feather, its dry weight and the strength of the seedling also had the highest rates when the T4 treatment reached 12.1 cm, 4 cm, 0.299 mg, 0.322 mg and 1.7000 respectively, with significant differences, while the rates were lower when the control (T1 treatment) the comparison amounted to 5.5 cm, 2.3 cm, 0.142 mg, 0.133 mg and 726.0 respectively.

Key Words *Natural Materials ; Chickpea Plant ; Banana Peels ; Egg Shells ; Fertilizers ; Household Waste*

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Introduction

Most farmers frequently use chemical fertilizer in agriculture in order to meet their needs market crops. These fertilizers may contain many chemicals that are harmful the environment in a big way (Abdel latif,2022) and since the problem of household waste pollution is problem that threaten the existence and health of humans and form this standpoint, we as researchers can address them, these problems are solved by using household waste as natural organic fertilizer instead of chemical fertilizers. Many people throw away fruit peels without knowing that they are getting rid of a treasure costly. bananas are a popular tropical fruit that may people enjoy, and it is customary to get rid of them, the peel of fruit after eating it, as the banana peel contains a group of important elements, including phosphorus, calcium and magnesium with high percentages of minerals that constitute good nutrition for plants and it is important for building healthy roots and buds, strengthening stems and producing flowers and fruits as well as supporting healthy in all aspects. Banana a peel contains potassium as a fertilizer for plants which contributes to strengthening their roots, and also potassium helps in making water and nutrients well distributed in the spaces in regulating plant enzymes and making them all grow more vigorously (Decan,2021).it also improves soil properties with continued use and decompose slowly ,providing the plant with it needs periodically unlike chemical fertilizers which release all of their content into the soil at once and a large portion of it is lost ,it is wasted with irrigation water ,

While egg shells are great addition to most gardens and house plants because they contain calcium carbonate, which is needed for plant growth and whether the eggs are red or white it contains for potassium and phosphorus, gardening experts recommend adding crushed egg shells to any plant or garden to use as fertilizer and as an insect and pest repellent (Awad,2023).

The chickpea plant *Cicer arietinum* L. is an annual plant of the pea family and is characterized by being rich in fiber and protein and a source of iron, phosphorus, folic acid and nutrients (Hammed ,2022). The other as its seeds contain 18-30% protein ,73% carbohydrates and 1.5 -6 % fat (Hays and Mohammed ,2015) and (Kashamal,2021). it is considered one of the crops.

An important legume adapted to the conditions of arid and semi-arid regions of the world due to its ability the crop absorbs water from the soil very efficiently because it has a deep root system .it can reach water located deep in the soil (Jan ,2010). And it's believed it was first planted in the fertile crescent region between the Tigris and Euphrates rivers for 7,000 years ago, AD. then Syria and turkey approximately 5450 BC.M (Saxena and Singh ,1999).

It is a plant legumes are used in human and animal nutrition and are used in many food industries and medicinal and the continent of Asia is more specialized in growing this crop because of its

suitability to the conditions environmentally. the percentage of cultivated area reached 92% of total cultivated area globally, India ranks first in global production at 70%, followed by Pakistan and turkey. the kingdom of morocco is at the fore front of the Arab countries in chickpea production followed in importance by Syria (charly ,2008)

And due to lack of research and the studies in this field, so the aim of this studding was to use natural nutrient from materials or household waste and knowing its effect on chickpea plant in the laboratory and which is better than other materials as a way to preserve the environment or reduce the harmful effects of waste and materials chemical.

Materials and Methods

The experiment was conducted in the laboratories of the horticulture department/collage of agriculture /Al-Qadisiyah university for the purpose of study the effect of some household waste (natural materials) on the germination and seedling growth of chickpea (*cicer arietinum* L.)

The experiment included four treatments. T1 representing water distilled treatment (control), T2 treated with banana peels, T3 treated with egg shells and T4 represented a mixture from (T2+T3) with three replicates for each treatment using a randomized design complete (CRD).

prepare liquid nutrient: Preparing banana peels collected a quantity of banana peels, then soak the fresh banana peels in water for five days, then water saturated with beneficial elements from banana peels is used to treat the seeds of plant by sprinkling or soaking (Arab organization for industrial development and mining ,2019).

Preparing egg shells a quantity of egg shells was collected and the shells were broken into pieces then put them in a small bowl. add half a liter of water to the bowl containing the peels .it was left for 5 to 6 days, after which the existing water was used to germinate the chickpea seeds by spraying or wetting (Arab organization for industrial development and mining ,2019).

Seed Treatment: Seeds brought from agricultural offices were cleaned of impurities.

Agriculture: Chickpea seeds were planted after soaking them liquid natural fertilizer prepared with data 19-3-2023 in sterile glass petri dishes with a diameter 10 cm, 12 plates and a container on filter paper (5 seeds) in each dishes with three replicates according to the exact design (CRD).

After the germination process, the seedlings were liquid nutrient and irrigation continued throughout the planting period the control treatment was irrigated with distilled water in order to compare the results, and two weeks after planting it was taken the following measurements:

1. Germination rate: calculated according to the following equation (germination percentage=number of sprouted seed /total number of seeds x 100%) (Muhammad and Moayed, 1991)
2. Root and shoot length: the length of each them was measured with a graduated ruler and average extracted (hammand and kermer ,2009)
3. Dry weight of root and shoot (mg): after drying, weight an electric balance the dry weight was extracted.
4. Number of root branches: this is done by calculating the root branches of each plant
5. Seedling strength: it was calculated using the following equation:
Seedling strength =germination percentage % (root length + shoot length)
(Abdul Hussein, etal.,2016)

A Statically analysis: the data were analyzed statically for the studied characteristics according to Duncan's polynomial test at the level probability 5%.

Result and discuss

Table 1 show that there were no significant differences in the percentage means with different treatments, there was a noticeable increase in germination rates if treatment T2 and T4 gave a value of 100%, while treatment T3 gave a rate of 92%. The control treatment had a germination rate of 91.6%. Table 1 also, show that there were no significant differences in the average number of branches root that were reached the highest number of branches in treatment T2, T4 which was 18.3 branch and 18.6 branch, respectively. And table 1 indicate to significant differences in the average root length with variation of treatment. The treatment T4 gave the highest value of 21.1 cm, which did not differ significantly for the T2 treatment, which gave a value of 11.5 cm compared to the comparison treatment, T1which gave the lowest average was 5.5 cm.

There were no significant differences between the average length of the feather for chickpea plants there was a noticeable increase in the length of the shoots, reaching the highest value at treatment T2, T4 (4.7 and 4.8cm) respectively.

Table 1. effect of natural materials on some growth indicators of chickpea plant seedling.

Treatment	Germination of percentage %	No. of radicle branches	Radicle length	Plumule length
T1	91.6 a	14.3 a	5.5 b	2.3 a
T2	100 a	18.3 a	11.5 a	4.7 a
T3	92 a	16.3 a	6.7 b	3.0 a
T4	100 a	18.6 a	12.1 a	4.8 a

An adjective that has similar letters this means are no significant differences between the means, while different letters means there are significant differences between the means, At the probability level 5% according to duncan's multinominal test.

Table 2 show that there are a significant difference between the average root dry weight, the highest dry weight reached 0.299 mg in the T4 treatment and 0.268 mg in the T2 treatment, without a significant differences between the two treatments compared to the comparison treatment T1, which differed significantly from the previous two treatments gave the lowest root dry weight of 0.142 mg.

Show it also, that there is a significant difference between the average dry weight of plumule. The highest dry weight of chickpea seedling reached 0.322 mg in the T4 treatment, while it gave the comparison treatment T1 had a minimum dry weight of 0.133 mg with significant difference.

Table 2 indicate that there are significant differences in the average seedling strength of plant chickpea had the highest value in the T4 treatment and the lowest value in the T1 treatment (control).

Table 2. effect of natural materials on dry weight and growth seedling of chickpea plant

Treatment	Dry weight of radicle	Dry weight of plumule	Power growth of seedling
T1	0.142 b	0.133 b	726.66 a
T2	0.268 a	0.162 bc	1.6300.0 b
T3	0.173 b	0.175 c	881.66 a
T4	0.299 a	0.322 a	1.7000.0 b

An adjective that has similar letters this means are no significant differences between the means, while different letters means there are significant differences between the means, At the probability level 5% according to Duncan's multinominal test.

The reason for the increase in T4 and T2 treatment is most likely due to the fact that banana peels and egg shells contain some important nutrients (essential nutrients) in fertilizer. that plant needs for growth ,as banana peels contain a high percentage of magnesium ,potassium ,calcium ,phosphorous and sulfur .also , which is needed for plant growth These substances are considered beneficial minerals for plant growth ,as they support the plant in performing chemical and metabolic process and also enhance the transfer of plant cells (Hikal ,2022) .while egg shells contain calcium carbonate, that help lower pH level of soil and make the environment more pleasant alkaline ,which is preferred by many crop-producing plants (Awad,2023) .This agrees with researcher Abo El-Enin ,et.al.,2015 on wheat plant so ,using banana increased the productivity of plant.

Conclusion

We conclude from research that the use of natural materials (egg and banana) has given good growth results using a mixture of banana peels and egg shells had the highest results for chickpea seedling growth indicators.

Recommendation

We recommend using other environmentally friendly natural materials instead of harmful chemicals for the environment in the agricultural field. And apply the idea of research in the field instead of laboratory application to obtain the best results

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Mutual Cooperation and Potential Conflicts: The Dynamic Relationship between Helpful Gut Bacteria and Intestinal Parasites in Human Digestive Well-being. A comprehensive review

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Abstract

A significant number of bacteria residing in the mammalian intestinal tract inhabit the surface of the intestinal lining. These microorganisms serve crucial functions in numerous physiological processes such as digestive and metabolic processes, Control and regulation of the immune system, Utilization of energy, Growth of the mucosal lining, and the preservation of protective barriers (Sun and Chen 2019).

The human digestive system hosts a wide range of microorganisms, which encompasses beneficial intestinal microflora and intestinal parasites. This research investigates the intricate relationship between these two groups in the context of human digestive health. While beneficial gut bacteria have a crucial function in aiding digestion as well as maintaining overall health and wellness, intestinal parasites pose a persistent challenge to this delicate balance.

Intestinal parasites are a assortment of varied protozoa and worms that can cause a wide range of health problems, specifically in areas with inadequate hygiene and restricted entry to medical care. Efforts to control these infections include both treatment and preventive measures, underscoring the importance of public health initiatives and ongoing research in combatting these parasites.

Aim of study: This study examines the fundamental mechanisms that govern the dynamic interaction between beneficial bacteria and intestinal parasites, shedding light on instances of mutual cooperation and potential conflicts. Helpful microbes contribute to absorption of nutrients, control of the body's defense system, and protection from harmful invaders. Conversely, intestinal parasites can disrupt these processes, leading to infections and compromised health.

Gaining a deeper understanding of the equilibrium between these microorganisms is essential for comprehending their collective impact on human digestive health. This research investigates the consequences of this interaction, both advantageous and disadvantageous, on overall well-being, and takes into account potential therapeutic approaches to maintain a harmonious gut microbial community. As we navigate the complexities of this dynamic relationship, we gain valuable insights into the preservation and restoration of digestive well-being amidst microbial diversity and potential challenges.


Key Words *Mutual Cooperation ; Beneficial Gut Bacteria ; Host-Parasite Relationships ; Parasitic Infections ; Probiotics*

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Introduction

The growing importance of microbiota research positions it as a pivotal domain with the potential to contribute significantly to the battle against parasitic diseases and the advancement of future disease treatments.

The diversity in microbiota composition among individuals underscores its fundamental role in maintaining overall health. Disturbances in microbiota equilibrium have been associated with a Comprehensive range of health issues, encompassing autoimmune disorders, diabetes, cardiovascular ailments, and even mood disorders such as depression. Intriguingly, parasites, which rely on a host for their survival, intricately interact with various elements of the microbiota.

Intestinal parasitic infections present a formidable global health dilemma, predominantly affecting underprivileged communities in numerous developing regions. Despite the implementation of various preventative measures to control these infections, there is a notable absence of uniform approaches to diagnose and tracking the frequency of intestinal parasitic infections.

Interactions among Intestinal Microorganisms and Parasites

The relationships among intestinal microorganisms and parasites represent a dynamic as well as complex relationship within this gastrointestinal tract. These interactions have profound implications for both host health and disease. Gut bacteria, also known as the gut microbiota, play a crucial function in diverse physiological functions. Conversely, parasites are organisms that inhabit a host's body to obtain nourishment and cause diseases in the process.

Understanding how gastrointestinal flora and parasites interact is essential for unraveling their influence on the host's overall well-being. These exchanges can influence immune reactions, inflammation, and the balance of microorganisms residing in the gastrointestinal tract. This intricate interaction has implications for the development and treatment of various diseases, making it a subject of increasing importance in research in the biomedical field. Within this framework, exploring the processes and results of these interactions can supply meaningful observations into host-parasite relationships and their wider consequences for health. There are numerous instances that illustrate this interaction.

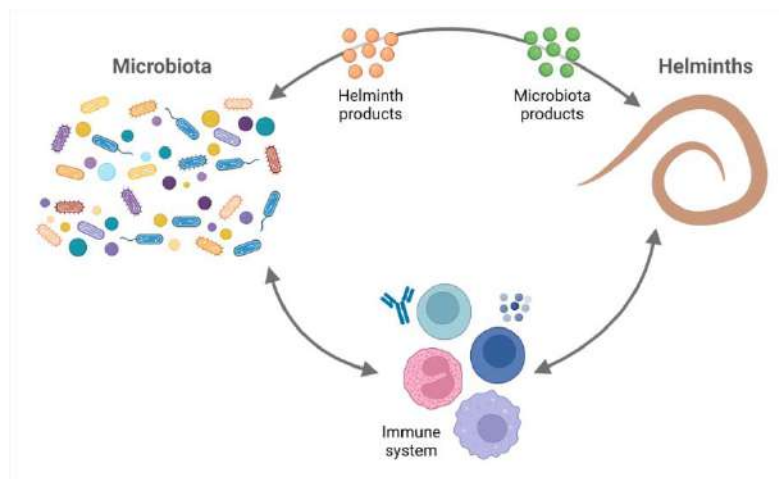


Figure 1. Helminthes and Bacterial Microbiota ((Linás-Caballero and Caraballo, 2022)

The beneficial microorganism *Enterococcus faecium* SF68 was found to enhance the generation of particular antibodies against *Giardia intestinalis* in the intestines of infected mice. This immune response included an elevation in the production of *Giardia*-specific IgA immunoglobulins in the intestines and IgG antibodies in the blood. Additionally, there was an increase in the Proportion of CD4+ T cells in the intestinal lymphoid tissue and spleens of mice nourished with SF68 (Benyacoub et al., 2005).

Moreover, *Blastocystis* has been implicated in altering the inflammatory status of the intestine, potentially causing gastrointestinal symptoms. However, it additionally performs a crucial function in preserving gut health by enhancing bacterial variety and abundance. There is a connection between *Blastocystis* and alterations in the composition of the intestinal flora, as indicated by exchange in the Firmicutes to Bacteroidetes proportion. Research has indicated that in people with a diagnosis of irritable bowel syndrome those who also possess an *Blastocystis* infection, there is a significant reduction in the bacterial strains *Bifidobacterium* and *Faecalibacterium prausnitzii*, which having anti-inflammatory characteristics. *Lactobacillus* species have been noticed to decrease the occurrence of *Giardia*, while their bacteriocins inhibit parasite attachment. (Beyhan and Yıldız, 2023).

Helminthes have also been related with shifts in microbiota composition, from the Bacteroidetes to the Firmicutes and Clostridia. Chronic *Trichuris muris* infection, for example. Results in reduced microbial diversity within the gut microbiota. And can negatively impact enhanced growth and improved nutrient utilization. These helminthes infections can indirectly influence the emotional state of children and conduct by impacting the microbiota. normal flora in the intestines have been found to reduce vulnerability to *Giardia lamblia* infection These beneficial bacteria may provide protection against infection and promote digestive health (Alak et al., 1999; Singer and Nash, 2000).

Lactobacillus changes in the amounts of Escherichia coli, and Bifidobacterium and decrease the intensity related with the infection because increased levels of Lactobacillus in the intestines diminish the Probability of the parasite establishing in the digestive system (John et al., 1997).

Research has also shown a association between the quantities of some bacteria and the existence of the Entamoeba histolytica in t children who have dysentery. changes in Escherichia coli, Bifidobacterium, and Lactobacillus level were notice within the intestines of infected children, suggesting that E. histolytica induces modifications in the dominant bacterial species within the digestive system (AlSalim and Hassen, 2023).

moreover, probiotics, including extracts from Lactobacillus acidophilus bacteria, have been discovered to hinder the attachment and proliferation of Giardia in studies conducted in a laboratory setting These probiotics reduce reduce parasite density and alleviate intestinal damage in Giardia-infected mice, particularly through the action of bacteriocins (Yuan et al., 2021).

In summary, these findings emphasize the effectiveness of certain probiotics in averting the attachment and growth of harmful organisms in the intestines, such as the Giardia parasite. These probiotics can play a beneficial role in promoting digestive system health.

The relationships between bacteria and cells lining the gastrointestinal mucosa are critical in infection of Irritable Bowel Syndrome and its associated symptoms. studies have suggested a potential role for the protozoan Blastocystis, which is highly prevalent in IBS patients, in altering the composition of the gastrointestinal microbiota (Olyaiee et al., 2022).

In one study, 16S ribosomal RNA sequencing was used to investigate the dynamics of gut microbiota at many stages of T. spiralis . The results suggested that certain microbial groups, including Proteobacteria and Ruminococcus, might contribute inflammation of intestine by producing ceramides following T. spiralis infection. The gut microbiota was found to play a role in ejecting parasites through Participation in Immunity related to mucous membranes and the promotion responses mediated by Th2 cells, with key factors including CD4+ T lymphocytes, interleukin-4 (IL-4), and secretory immunoglobulin A . These findings provide valuable Understanding of the intricate relationships among parasites, the microbial community in the gastrointestinal tract, and the organism, significantly advancing our understanding of host-parasite interactions (Li et al., 2023).

The interaction between intestinal parasites and bacteria can range from equilibrium to competition. Active protozoan invasion can modify the interaction between the host and its resident microflora, potentially leading to dysbiosis and inflammatory disease. On the other hand, the

microbiota can control the settlement, multiplication, and virulence of parasites, influencing the outcome of infection.

There are several hypotheses that can explain the limited impact of beneficial bacteria on the growth of harmful organisms (Leung et al.,2018) including parasites. This is achieved through preventing their attachment, metabolic interactions, competition for space, competition for nutritional resources, and stimulation of the host immune response(Dai et al.,2019). Consequently, this gives rise to what is known as microbiota colonization resistance (Dodge et al,2021)On the other hand, harmful organisms have evolved counterstrategies to expand their populations and increase their virulence to cause infection(Estrela et al.,2021).

Studies indicate that infection with worms like *Schistosoma* can cause changes in the composition and function of the intestinal microbiota. Additionally, the removal of intestinal bacteria through antibiotic treatment in mice led to a slight increase in worm burdens in secondary infections, suggesting that the microbiota influences the effectiveness of the immune response against worm infections. The microbiota appears to impact the Th2 immune response, which is crucial in defending against parasitic worms) Cinzia,2023).

the study examined the impact of two probiotic mixtures on the interaction with the parasitic worm *Oesophagostomum dentatum* in pigs. The first mixture was *Bacillus amyloliquefaciens*, *Bacillus subtilis*, and *Enterococcus faecium* (BBE), while the second mixture contain of *Lactobacillus rhamnosus* LGG and *Bifidobacterium animalis* subspecies *Lactis* Bb12 (LB). The use of these mixtures aimed to investigate their effects on the parasitic worm's motility and their impact on immune responses.

The results of using the first mixture (BBE) showed alterations in bacterial diversity in the colon and feces, with an improvement in the balance of *Bifidobacterium* bacteria. Additionally, it led to a reduction in the expression of genes associated with Type 2 inflammation and mitigated the impact of the worms on the lymphocyte ratios in the ileo-cecal lymph nodes, restoring them to their normal levels. BBE also decreased the secretion of inflammatory cytokines. While, the second mixture (LB) exhibited a strong effect on changing the bacterial composition in the colon and significantly influenced the expression of genes associated with inflammation.

That is mean the first mixture (BBE) showed effects on bacterial diversity, immune gene expression, and mitigating the impact of parasitic worms, while the second mixture (LB) had a notable influence on bacterial composition and gene expression related to inflammation. (Laura et al.,2021)

The study, which investigated the impact of cystic echinococcosis (CE) infection on the gut microbiota of mice, revealed changes in the bacterial composition in the intestines of infected mice. Specifically, certain bacterial families, such as *Streptococcaceae*, and the genus *Streptococcus*, showed

an increase in abundance in the intestines of infected mice. Additionally, the study observed a decrease in bacterial diversity in the intestines of infected mice compared to healthy mice.

Furthermore, the research indicated that the parasitic infection influenced changes in metabolic pathways related to the gut microbiota. These findings suggest that the interaction between the parasitic infection and the gut microbiota can lead to alterations in the bacterial composition and metabolic pathways in the host's intestines.) Patrick,2022).

In a study conducted by Francisca(2015), who performed an experimental infection of mice with the intestinal helminth *Trichuris muris*, the study revealed that the infection of mice with this parasite leads to significant changes in their gut microbiome. The diversity and abundance of bacteria, specifically Parabacteroidetes, Prevotella, and Bacteroidetes, decreased. Microbial disturbances were associated with a substantial decrease in the levels of vitamin D derivatives. Additionally, the infection led to a reduction in the breakdown of plant-derived carbohydrates involved in amino acid synthesis. Conversely, a significant increase in the number of amino acids was observed. These findings highlight the intricate interplay between helminth infection and the host's gut microbiome, impacting nutritional metabolism and amino acid composition.

In another study conducted on *Trichuris muris*, intestinal nematoda of mice, the diversity of the bacterial community was studied. By comparing the diversity using beta diversity analysis among those infected with the parasite, individuals free from infection, and those treated with anthelmintic drugs, the results indicated that parasitic infection could influence the composition of the intestinal bacterial community. The most notable impacted bacterial families were Leuconostocaceae and Bacteroidaceae.(Jenkins et al.,2017).

In another study that investigated the microbial composition in the bile and intestines of hamsters infected with the parasite *Opisthorchis viverrini*, a parasite that can lead to cholangiocarcinoma in humans, it was observed that the infection with the parasite affected the microbial biodiversity in the hamster's digestive system. Certain bacterial families such as Lachnospiraceae, Ruminococcaceae, and Lactobacillaceae increased, while others such as Erysipelotrichaceae and Eubacteriaceae decreased. The study suggested that the parasite and its associated microbes may collaboratively contribute to enhancing a distinctive immune response, consequently promoting inflammation and the formation of scars around the bile ducts. This scarring is considered an early stage in cholangiocarcinoma.) Plieskatt et al.,2013).

Cooperation and Mutual Benefits

Cooperation and mutual benefits in biology are intriguing phenomena where various organisms interact for mutual advantage. One area of interest involves the relationships between gut bacteria and parasites, challenging the traditional view of parasites as solely harmful invaders. Emerging research shows instances in the human gut where gut bacteria and parasites engage in mutually beneficial relationships.

This concept prompts exploration of nuanced dynamics. Instances of cooperation between gut bacteria and parasites are essential, sometimes benefiting the host. These relationships take various forms, aiding in parasite expulsion or regulating the host's immune response.

In this discussion, we'll explore specific examples where certain gut bacteria assist in parasite expulsion or modulate the host's immune system, promoting the host's overall health and well-being. This focus on the balance within the gut microbiome and its impact on host-parasite interactions.

Recent research on the microbiota that have been infected with *Trichuris* spp. Has suggested a link between the existence of *Trichuris* parasites and alterations in the composition of the microbiota.

Cutting-edge methods like metagenomic analysis have recently shown that parasitic worms such as *Trichuris* spp. can coexist with bacterial communities containing *Bartonella*. Furthermore, potentially pathogenic bacteria like *Clostridium*, *Aeromonas*, *Escherichia*, *Salmonella*, *Rickettsia*, and *Mycobacterium* have been detected alongside them. This raises concerns about a potential new risk to humans if these nematodes become vectors for transmitting novel diseases. Consequently, it is essential to acquire a more profound insight of the interplay between parasites and bacteria. (García *et al.*, 2022).

Conclusion

Our exploration into the complex relationship between gut bacteria and gut parasites unveils a fascinating interplay of cooperation, conflict, and mutual influence within our digestive systems. While traditionally viewed as adversaries, these microorganisms and parasites engage in a dynamic partnership that significantly impacts our health. Beneficial gut bacteria, our allies, play a vital role in promoting digestion, boosting our immune system, and maintaining a balanced microbiome. They act as guardians of our gut, ensuring its harmony and functionality. Conversely, intestinal parasites disrupt this equilibrium and present health challenges. They can trigger infections and various issues. However, it's not a one-sided story; some parasites can positively contribute to our gut environment, enhancing microbial diversity. Throughout our journey, we've encountered examples of how specific probiotics enhance our immune response against parasites, protect us from infections, and support

digestive health. We've witnessed how certain microbes affect gut inflammation and microbiota composition, both positively and negatively. In the context of parasitic diseases, our understanding of the micro biota's role holds promise. It offers new insights into combating infections and developing innovative treatments. By studying these interactions, we uncover fresh ways to maintain digestive well-being amid diverse microbial challenges. Ultimately, this dynamic relationship emphasizes the importance of balance and harmony within our gut microbiome. It reminds us that our internal world is a complex ecosystem where cooperation, conflicts, and mutual benefits shape our health. As we continue to unravel this relationship, we gain valuable insights that may lead to breakthroughs in health and medicine, offering hope for a healthier future.

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مستوى الافصاح عن المعلومات المالية المتعلقة بالاستدامة على وفق معيار (IFRS-S1) وتأثيره على أداء الشركة – بحث تطبيقي في عينة من المصارف الاسلامية العراقية

The level of disclosure of financial information related to sustainability according to the IFRS-S1 standard and its impact on the company's performance - applied research in a sample of Iraqi Islamic banks

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Abstract

The research aims to verify the extent to which the requirements for disclosure of financial information related to sustainability are applied according to the IFRS-S1 standard, and its impact on the company's performance, on a sample of Islamic banks listed in the Iraq Stock Exchange, which number (5) banks as a prospective study. By analyzing the content of the annual financial reports of the banks, the research sample for the year 2022. By using the disclosure matrix of the aforementioned standard, which consists of four dimensions (governance, strategy, risk management, Metrics and Target) to measure the quality of disclosure of the research sample. And the adoption of a mathematical model developed by the researcher to measure the performance of banks is based on previous literature on the subject. The SPSS statistical program was adopted to analyze the data and access the results. Which was represented by the existence of a weakness in the level of disclosure of sustainability according to the IFRS-S1 standard in the Iraqi Islamic banks, the research sample, which negatively affected the reliability of the information included in the annual reports and the company's performance. And the disclosure of sustainability information about a company may negatively affect its performance in the short term and positively in the long terms.

Key Words *Financial disclosure ; Sustainability ; IFRS-S1 Standard ; Company's Performance*

ملخص

يهدف البحث الى التحقق من مدى تطبيق متطلبات الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفق معيار ((IFRS-S1) واثار ذلك على أداء الشركة، على عينة من المصارف الاسلامية المدرجة في سوق العراق للاوراق المالية، والبالغ عددها (5) مصارف كدراسة استباقية، عبر تحليل محتوى التقارير المالية السنوية للمصارف عينة البحث لسنة 2022. باستخدام مصفوفة الافصاح الخاصة بالمعيار المذكور، والمتكونة من أربعة ابعاد (الحوكمة، الإستراتيجية، إدارة المخاطر، والاهداف والمقاييس) لقياس جودة الافصاح لعينة البحث. واعتماد أنموذج رياضي مطور من قبل الباحثة لقياس اداء المصارف يستند الى الادبيات السابقة بالموضوع. كما تم اعتماد البرنامج الاحصائي SPSS لتحليل البيانات والوصول الى النتائج. التي تمثلت بوجود ضعف في مستوى الافصاح عن الاستدامة وفق معيار ((IFRS-S1) في المصارف العراقية الاسلامية عينة البحث، مما انعكس سلباً على موثوقية المعلومات التي تتضمنها التقارير السنوية وعلى أداء الشركة. وأن الافصاح عن معلومات الاستدامة الخاصة بشركة ما قد تؤثر سلباً على أدائها في المدى القصير وإيجابياً على المدى الطويل.

الكلمات المفتاحية *الافصاح المالي؛ الاستدامة؛ معيار (IFRS-S1)؛ أداء الشركة*

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المقدمة

زاد الاهتمام من قبل دول العالم الى تحقيق التنمية المستدامة وسعت الى اصدار القوانين والتشريعات التي تنظم هذا الاطار، وعدت الاستدامة منهجاً مستقبلياً للوحدات الاقتصادية تسعى لتحقيقه. خاصة بعد ازدياد مطالبات المنظمات والتجمعات المهنية المحاسبية للإبلاغ عن ابعاد الاستدامة وعدها جزءاً متمماً للقوائم المالية. وقد انشأ مجلس معايير المحاسبة الامريكي (FASB) مجلس معايير محاسبة الاستدامة (SASB)، والذي تولى اصدار معايير محاسبة الاستدامة في ضوء المبادرة العالمية للإبلاغ (Global Reporting Initiatives (GRI

وقد تبنت العديد من الوحدات الاقتصادية ابعاد الاستدامة في اعمالها وادائها الاقتصادي والاجتماعي والبيئي والالتزام بمتطلبات الحاكمية. (Al-Amiri & Ahmed, 2015) كما تبنت العديد من الدول نهج الإبلاغ عن الاستدامة في تقاريرها المالية السنوية مما يزود اصحاب المصلحة بمعلومات تدعم قراراتهم.

وفي فترة لا تتجاوز الثلاثين عاماً حققت الصيرفة الاسلامية العديد من الانجازات في الدول العربية، وتزايد حجم اصولها التي تديرها، ويرجح المحللون نجاح هذا النوع من المصارف أساساً الى الفكر الذي تقوم عليه، وللنتائج التي حققتها على الصعيدين الاجتماعي والاقتصادي، اذ تلتزم المصارف الاسلامية باداء دور اجتماعي في اطار نشاطاتها وفقاً لمنطق عملها الذي يفرض عليها ان تزواج اختيارها للاستثمارات والمشاريع التي تمويلها او تشارك فيها بين هدف الربحية والاهداف الاجتماعية والبيئية.

بناءً على ما تقدم سيتم مناقشة البحث وفقاً للمحاور الآتية: المحور الاول يتضمن منهجية البحث ، المحور الثاني الاطار النظري للبحث ويشمل (محاسبة الاستدامة، المعيار الدولي للإفصاح (IFRS S1) ، المحور الثالث الإطار التطبيقي، والمحور الرابع الاستنتاجات والتوصيات).

منهجية الدراسة

مشكلة الدراسة

تحتل التنمية المستدامة مكانة بالغة الاهمية بسبب علاقتها برفاهية الانسان والحفاظ على الثروات، مما انعكس على الحاجة الى توفير المعلومات المناسبة، اذ اصبحت المحاسبة التقليدية عاجزة عن توفير متطلبات الاستدامة. مما تطلب التحول الى محاسبة الاستدامة. وان الافصاح عن المعلومات والبيانات الاقتصادية والبيئية والاجتماعية والحوكمة الوسيلة التي تلجأ اليها الشركات التي تهدف الى الاستمرار وعكس صورة ايجابية عن اداؤها لدى اصحاب المصلحة والمجتمع. وتعد المصارف وخاصة الاسلامية، من المؤسسات التي تهدف من خلال ماتقدمه من أنشطة الى ان يكون لها أثر على التنمية الاجتماعية، فضلاً عن تحقيق الازدهار وتحقيق التنمية المستدامة. وعليه فان الايفاء بمتطلبات المعيار الدولي للافصاح عن المعلومات المالية المتعلقة بالاستدامة (IFRS S1) من شأنه ان يحقق اهداف التنمية المستدامة. بناءً على ما تقدم فان التساؤل المطروح، هل تحوي التقارير السنوية للمصارف الاسلامية عينة البحث على المعلومات المالية المناسبة للافصاح عن الاستدامة وفقاً للمعيار الدولي (IFRS-S1) وما انعكاس ذلك على أداء.

الأهداف

- 1- تحليل وقياس مستوى الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفق معيار (IFRS-S1) في التقارير السنوية للمصارف عينة البحث لتعزيز جودة المعلومات الواردة فيها.
- 2- تحديد العلاقة بين جودة الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفق معيار (IFRS-S1) وأداء الشركة.

أهمية البحث

تنبع اهمية البحث من الآتي:

- 1- اهمية الافصاح عن المعلومات المالية ذات العلاقة بالاستدامة التي تعكس شفافية الابلاغ المالي لتقييم أفضل لأداء الشركة. كما تزيد من قدرة الشركة التنافسية في السوق وتجذب الاستثمارات وتزيد امكانات وقيمة الشركة الاقتصادية. ويعزز الافصاح عن أنشطة الشركة التوجه العالمي نحو تحقيق التنمية المستدامة.
- 2- يزيد الافصاح عن أنشطة الشركة في تقاريرها السنوية، موثوقية المعلومات لاصحاب المصلحة، وتعد مرجعاً لهم لاتخاذ القرارات والتنبؤ بالمخاطر المستقبلية. وتأثير التنبؤ بالمخاطر المتعلقة بالاستدامة على التدفقات النقدية للمصارف وادائها.
- 3- حادثة موضوعه، والمتمثل في الافصاح المالي عن الاستدامة وفقاً للمعيار الدولي (IFRS-S1). وفي معرفة مستوى افصاح المصارف الاسلامية العراقية عنه. وانعكاس ذلك على اداء الشركة.

الفرضيات

- H1: تتضمن التقارير السنوية للمصارف العراقية الاسلامية افصاحات كافية عن المعلومات المالية ذات العلاقة بالاستدامة وفقاً لمتطلبات المعيار الدولي (IFRS-S1).
- H2: يوجد تأثير ذو دلالة معنوية لجودة الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفقاً لمتطلبات المعيار الدولي (IFRS-S1) على أداء الشركة.

المنهج المستخدم

استخدم البحث المنهج الوصفي التحليلي والذي يهتم بوصف الظاهرة ويعبر عنها تعبيراً كمياً ونوعياً، وتفسير العلاقات السببية بين متغيرات البحث.

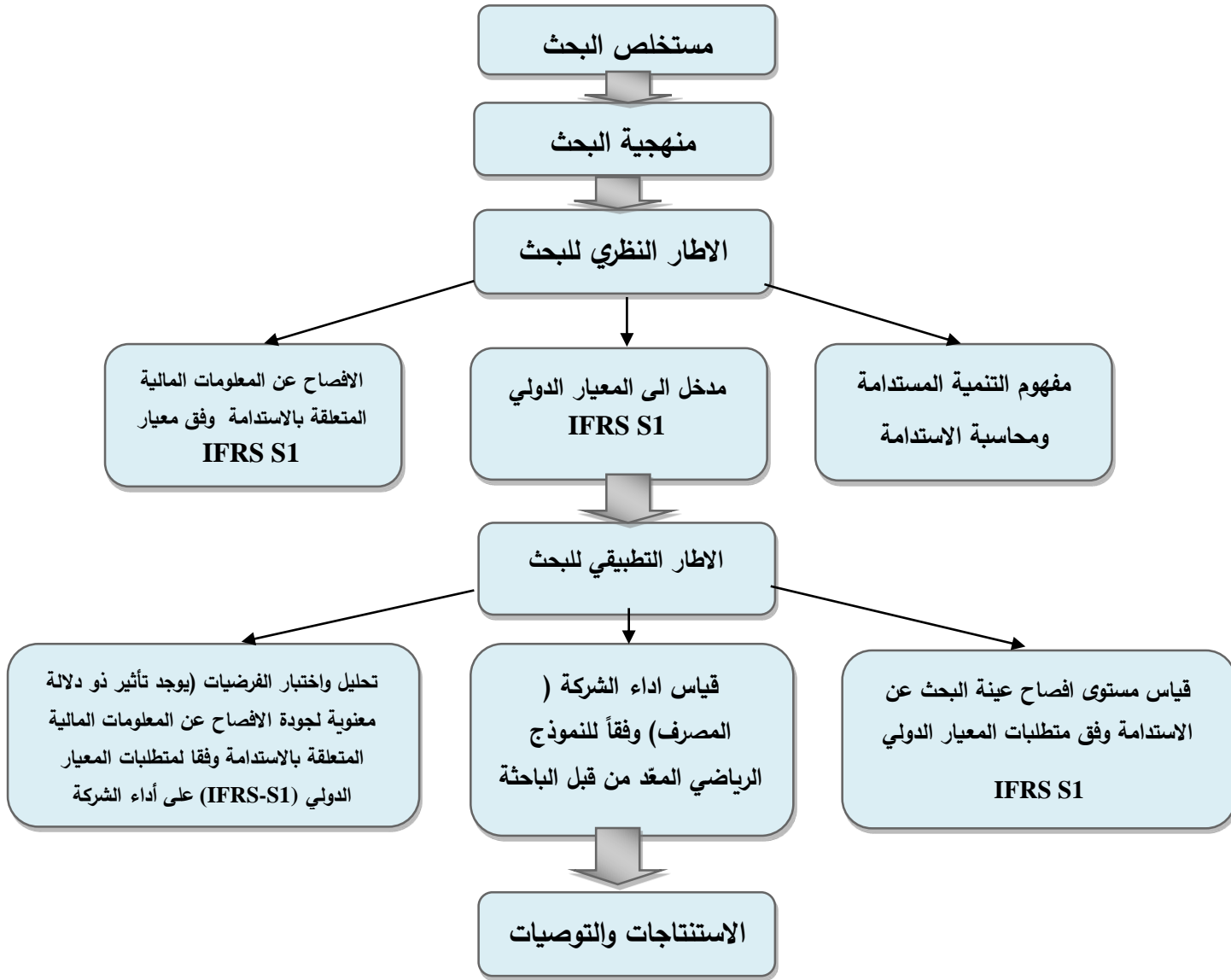
حدود البحث

يتكون مجتمع البحث من المصارف العراقية الاسلامية المدرجة في سوق العراق للاوراق المالية والبالغ عددها (22) مصرف. اما عينة البحث فتتكون من اعلى (5) مصارف بقيمتها السوقية بتاريخ البحث، والتي توفرت تقاريرها المالية لسنة 2022 وتدعم بياناتها التحليل، والتي يمكن دراسة مستوى افصاحها عن متطلبات معيار الابلاغ المالي (IFRS-S1).

النماذج التجريبية وقياس المتغيرات

لقياس مستوى افصاح عينة البحث عن الاستدامة وفق معيار IFRS S1 تم الاطلاع على اصدارات IFRS الخاصة بالمعيار المذكور وعلى الدراسات السابقة ذات العلاقة بالموضوع والاستفادة من ادواتها لبناء وتصميم قائمة فحص مستوى الافصاح.

ومن اجل قياس اداء المصارف تم اعتماد الأنموذج المنقح من قبل الباحثة والمستند الى دراسة (Lopez et al., 2007) (Ameer& Othman, 2012) (Roberts& Dowling,2022) (Grag, 2015) (Laskar& Maji, 2016)) ثم استخدام البرنامج الاحصائي (SPSS) لقياس مستوى الارتباط والتأثير بين متغيرات البحث.



الشكل 1. مخطط تعريفى بالبحث An introductory outline of the research

الإطار النظري

1. التنمية المستدامة ومحاسبة الاستدامة

تم تعميم مفهوم التنمية المستدامة لأول مرة من قبل اللجنة العالمية للبيئة والتنمية (WCED, 1987). منذ ذلك الحين، تحولت الاستدامة إلى استراتيجية عمل أساسية من خلال التفكير بالقضايا الاقتصادية والاجتماعية والبيئية بطريقة متوازنة وشاملة تعود بالفائدة للأجيال الحالية والمستقبلية (Dyllick & Hockerts, 2002) (Elkington, 1994). ونتيجة لذلك، أدى أداء الاستدامة للشركات إلى ظهور تغيير ثوري في عملية الإدارة التقليدية من خلال التركيز ليس فقط على الجانب الاقتصادي ولكن أيضاً على الأبعاد الاجتماعية والبيئية لتحقيق متطلبات المجتمع. فعندما تقوم الشركة بأنشطة تجاه هذه الأبعاد، فمن المهم إبلاغها بشكل فعال إلى أصحاب المصلحة في شكل تقرير. (Yaqoob, 2019) نتيجة لذلك، يظهر تقرير الاستدامة كأداة حيوية تساعد

الشركات في التواصل مع القضايا المتعلقة بالاستدامة (Caron and Turcotte, 2009) ويساعد إعداد هذه التقارير في تطوير علاقة صحية مع أصحاب المصلحة، وهو أمر بالغ الأهمية من أجل البقاء والنجاح على المدى الطويل (Lopez et al., 2007) وبتعبير آخر، يمكن تحقيق ميزة تنافسية مستدامة من خلال الانتباه إلى ثلاثة أبعاد واسعة للتنمية المستدامة، التنمية الاقتصادية، والنهوض الاجتماعي والحفاظ على البيئة (Gladwin et al., 1995). ومن منظور أصحاب المصلحة، يوفر تقرير الاستدامة وسيلة لقياس أداء الشركة وتقييمه نحو التنمية المستدامة. ولتسهيل إعداد مثل هذه التقارير، تم تطوير أطر هذه التقارير على مر السنين (Al-Jajawi & Al-Mamouri, 2022). إذ تم تطوير دليل الإبلاغ عن الاستدامة بواسطة Global Reporting (GRI) وهو الإطار الأكثر استخدامًا في اقتصادات العالم المتقدمة والناشئة. (Carrots & Stick, 2013) ان الهدف الأساسي لأي تقرير استدامة هو تعزيز الشفافية لتقييم أفضل لأداء الشركة. ولا يمكن تحقيق ذلك إلا من خلال الإفصاح عن المعلومات بموضوعية ودقة (Laskar & Maji, 2016).

وتعرف محاسبة الاستدامة بأنها نظام معلومات يهدف إلى تقييم الأداء البيئي والاجتماعي والحوكمة، من خلال ادارتها لمختلف اشكال راس المال غير المالي المرتبط بقضايا حوكمة الاستدامة البيئية والاجتماعية والبشرية (Al-Sharea et al., 2021)، لغرض انشاء قيمة مستدامة طويلة الاجل تلبى احتياجات الحاضر دون المساس بقدرة الاجيال المقبلة على تلبية احتياجاتهم الخاصة، وهي مكملية للمحاسبة المالية بحيث يمكن تقييم المعلومات المالية ومعلومات الاستدامة جنباً إلى جنب، وتوفير رؤية كاملة لاداء الوحدة الاقتصادية وخلق قيمة مالية وغير مالية على جميع اشكال رأس المال للوحدات (SASB, 2013) كما وتعرف بأنها نظام متكامل يستعمل للقياس وللإفصاح عن التأثيرات البيئية والاجتماعية والاقتصادية للوحدة وتوصيل النتائج إلى متخذي القرار من اجل توضيح واثبات مشاركة الوحدة في تحقيق التنمية المستدامة (Badawi & Al-Beltagy, 2013).

2. اهداف محاسبة الاستدامة (SASB, 2013)

1. توفير معلومات محاسبية لأصحاب المصالح وفقاً لمبادئ الاستدامة لترشيد قراراتهم.
2. تقييم الأداء البيئي والاجتماعي من خلال ادارة رأس المال البيئي والاجتماعي.
3. تقييم مخاطر وفرص الاستدامة لترشيد قرارات التمويل والاستثمار.
4. تحديد المسؤوليات وتحقيق التوازن بين جميع مستخدمي المعلومات المحاسبية.
5. تطوير ابعاد النظام المحاسبي (Al-Azzawi et al., 2021).

لقد أصبحت الاستدامة اتجاهاً في ادارة القطاع الخاص. وتحول انتباه المستثمرين والمنظمين ليس فقط للنظر في الجوانب المالية للأداء ولكن للنظر في الجوانب غير المالية أيضاً (Vallon, 2022). وتظهر المعطيات والحقائق جدية واهتمام المؤسسات المختلفة بقضية الاستدامة، بما في ذلك وضع معايير لإعداد تقارير الاستدامة (Garvey et al., 2021). وينظر إلى الإبلاغ عن الاستدامة، ومعايير الاستدامة أنها لا تلبى احتياجات المستثمرين أو عدم تركيزها على المستثمر (Gold & Taib, 2022). ومن المتوقع ان تركز معايير الإبلاغ في المستقبل القريب، على المستثمرين بما يحسن من عملية صنع القرار بالاعتماد على المعلومات الناتجة من الإبلاغ عن الاستدامة.

ان معظم الإبلاغ الحالي عن الاستدامة لا يزال طوعياً، ولا يزال تنفيذ الالتزام بإعداد تقارير الاستدامة مقيد، بسبب عدم وجود معيار دولي واحد على مستوى العالم (Doni et al., 2020). وقد تم قبول معايير التقارير المالية كشكل من أشكال الإبلاغ عن تلك الشركات (Hasan & Ahmed, 2023) وفي نوفمبر 2021، أعلنت IFRS عن إنشاء مجلس معايير الاستدامة الدولية (ISSB)، والذي بدوره، أطلق معايير الإفصاح عن الاستدامة الخاصة بالمعايير الدولية لإعداد التقارير المالية (SDS). وتوفر هذه المعايير المبادئ العامة للشركات في الكشف عن معلومات الاستدامة (المتعلقة بالجوانب المالية). في 31 مارس في عام 2022،

أطلق ISSB مسودتين تطرقت الى المتطلبات العامة للإفصاح عن المعلومات المالية المتعلقة بالاستدامة (الاول) IFRS S1 : ينظم المعيار الدولي لإعداد التقارير المالية S1 المبادئ ومتطلبات الشركات في الإفصاح عن الاستدامة (المعلومات المتعلقة بالجوانب المالية). وتتضمن أربعة جوانب رئيسية يجب الإفصاح عنها وهي: (1) الحوكمة، (2) المخاطر، (3) الإستراتيجية و (4) المقاييس والاهداف.

اما (الثاني) المعيار الدولي لإعداد التقارير المالية S2 المتعلق بالمناخ. ينظم المعيار الدولي لإعداد التقارير المالية S2 معالجة الاستدامة والإبلاغ عن جوانب الإفصاح المتعلقة بتغير المناخ (Pratama et al., 2022)

3. الإفصاح عن المعلومات المالية المتعلقة بالاستدامة

ان الأطراف المستخدمة للقوائم المالية تحتاج إلى المعلومات التي ينبغي توفيرها من قبل معدي التقارير المالية. أذ ينبغي الإفصاح عن المعلومات المفيدة والمناسبة وإيصالها إلى اصحاب المصلحة في الوقت المناسب، ولكي تكون القوائم المالية قابلة للفهم ينبغي توفر الشفافية في مرحلة إعدادها، من خلال الأخذ بنظر الاعتبار الخصائص النوعية لتلك المعلومات. (Mohammed, 2009) (Abbas & Al-Dabbas, 2020) ومن الامور التي ينظر اليها اصحاب المصلحة هي المعلومات المالية المتعلقة بالاستدامة، وامكانية تأثيرها على قراراتهم الاستثمارية، والتي جاءت ضمن متطلبات تطبيق المعيار الدولي للإبلاغ عن المعلومات المالية المتعلقة بالاستدامة (IFRS S1) كونها تزودهم بتقييم المخاطر وآثارها والفرص المتاحة المتعلقة بالاستدامة وانعكاسها على تدفقاتهم النقدية وعلى قيمة الشركة في المدى القصير والطويل. والإفصاح عنها وتحميلها المسؤولية أمام أصحاب المصلحة داخل وخارج الشركة على حد سواء لقدرتها على إدارة النتائج الاجتماعية (Hamad et al., 2020) وبما يعزز قيمة الشركة وتحقيق أهداف التنمية المستدامة (Marina, 2022).

معيار IFRS S1 : الهدف الأساسي للمعيار الدولي لإعداد التقارير المالية IFRS S1 توفير إطار عمل للمبادئ العامة للإفصاح عن المعلومات الجوهرية حول الاستدامة لجميع المخاطر والفرص الكبيرة، التي من الممكن أن تكون معقولة، ومن المتوقع أن تؤثر على الكيان. من خلال التأثير على المركز المالي، النتائج، التدفقات النقدية، التمويل أو تكلفة رأس المال على المدى القصير أو المتوسط أو الطويل، الاستراتيجية، ونموذج الأعمال. وهو مفيد للمستخدمين الأساسيين للتقرير المالي (المستثمرين الحاليين والمحتملين، المقرضين والدائنين الآخرين). الذين يقررون الموارد التي يجب توفيرها للشركة (IFRS, 2023). كما تسمح للمستثمرين بتقييم قيمة الكيانات (Gaviria et al., 2023). يتضمن هذا المعيار متطلبات لمجموعة كاملة من الإفصاحات المالية المتعلقة بالاستدامة، والتي ستتركز على اعتبارات الشركة في أربعة محاور: حوكمتها واستراتيجيتها وإدارة المخاطر والمقاييس والأهداف. والتي تستخدم لقياس ومراقبة وإدارة الاستدامة المتعلقة بالمخاطر والفرص المتاحة. وهذه المحاور او الابعاد تتوافق مع توصيات (TCFD)* التي تم تكييفها مع افصاحات الاستدامة: (IFRS, 2022)

1- **حوكمة Governance** : معلومات حول ضوابط وإجراءات عمليات الحوكمة التي يستخدمها الكيان لرفع التقارير لمراقبة واستدامة المخاطر والفرص ذات الصلة، التي تؤثر على استدامة الشركة (IFRS) اي الإفصاح عن المعلومات حول من له دور في تحديد ورصد هذه المخاطر والفرص ، وماهي قدراتهم الفنية للقيام بذلك، وجوانب المكافآت المرتبطة بمعايير الحوكمة البيئية والاجتماعية وحوكمة الشركات. (Mohammed et al., 2021) وهي معلومات لتمكين المستثمرين من فهم عمليات الحوكمة داخل الشركة.

* Task Force on Climate-related Financial Disclosure TCFD فرقة العمل المعنية بالإفصاحات المالية المتعلقة بالمناخ وهي تقدم معلومات للمستثمرين حول ما تفعله الشركات للتخفيف من مخاطر تغير المناخ ، فضلاً عن أن تكون شفافة بشأن الطريقة التي تحكم بها. تأسست في ديسمبر 2015 من قبل مجموعة العشرين ومجلس الاستقرار المالي ، ويرأسها مايكل بلومبرج.

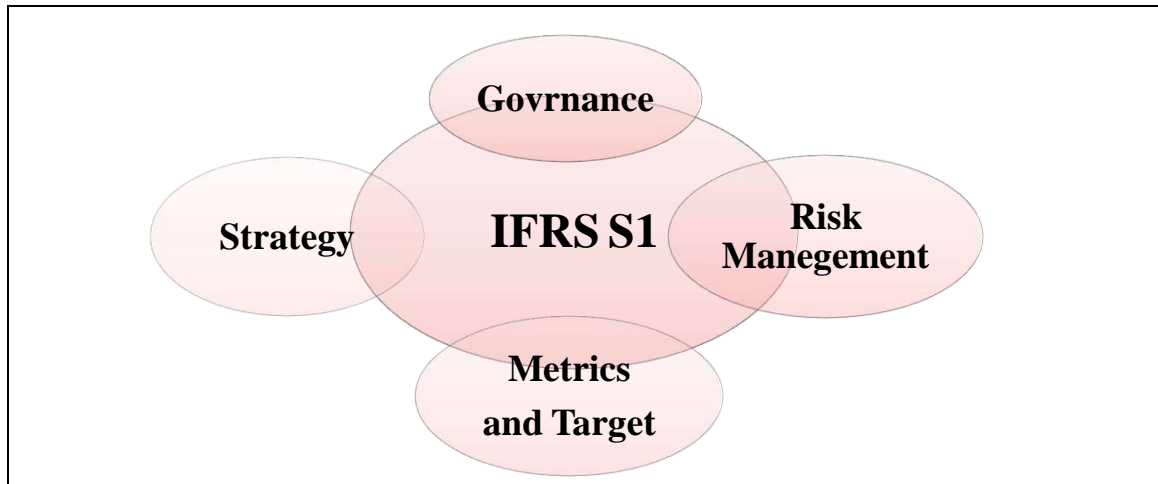
2- الإستراتيجية Strategy: معلومات حول استراتيجية الكيان لإدارة الاستدامة المتعلقة بالمخاطر والفرص. وهو نهج معالجة المخاطر والفرص المتعلقة بالاستدامة ، والتي يمكن أن تؤثر على نموذج الأعمال على المدى القصير والمتوسط والطويل. إذ تتضمن معلومات لتمكين اصحاب المصالح من تقييم استراتيجية الشركة لمعالجة المخاطر والفرص الكبيرة المتعلقة بالاستدامة. وما إذا كانت هذه المخاطر والفرص قد تم دمجها في التخطيط الاستراتيجي، بما في ذلك التخطيط المالي.

3- إدارة المخاطر Risk Management: معلومات حول كيفية تحديد المخاطر والفرص المتعلقة بالاستدامة وتقييمها، وما إذا كانت هذه العمليات مدمجة في الإطار الشامل لإدارة المخاطر وكيفية دمجها. وهي معلومات لتمكين اصحاب المصالح من فهم العملية التي من خلالها تحدد الشركة ، تقييم، وتدير الاستدامة المتعلقة بالمخاطر والفرص الحالية والمتوقعة. كما تساعد هذه المعلومات المستثمر لتقييم ملف المخاطر العام للشركة وعمليات إدارة المخاطر.

4- المقاييس والأهداف Metrics and Target: معلومات حول كيفية قيام الكيان بقياس وإدارة ومراقبة الاداء بمرور الوقت فيما يتعلق بالمخاطر (Garviria et al., 2023) والفرص المتعلقة بالاستدامة، وتقييم أهميتها، بما في ذلك التقدم المحرز نحو الأهداف التي حددتها. وهي معلومات لتقييم وإدارة ومراقبة أداء الكيان، فيما يتعلق بالمخاطر والفرص المتاحة.

تسعى معايير الاستدامة إلى تسهيل تقييم "قيمة الشركة" ، وهو مجموع رأس مال الشركة (القيمة السوقية) وقيمة صافي ديونها، مع الأخذ في الاعتبار أيضاً تأثير وتبعات الكيان على الناس والعالم والاقتصاد. إذ يجب أن تكون هذه المعلومات:

- تلبية احتياجات المستثمرين وأن تحدث فرقاً.
- كاملة ، خالية من الأخطاء ، محايدة.
- قابلة للتحقق (قابلة للتأكيد، قابلة للتدقيق) (Flayyih et al., 2022).
- قابلة للمقارنة (مع الفترات السابقة ومع الشركات الأخرى).
- في الوقت المناسب ، واضحة وموجزة.



الشكل 2. أبعاد اطار عمل معيار IFRS* S1

* المصدر: من اعداد الباحثة استناداً الى (IFRS, 2022)

إن المعلومات المالية وحدها لا تكفي لفهم أنشطة الشركة بشكل كامل وتأثيرها على اتخاذ القرار، بل يجب تطوير محتوى التقارير المالية لتتضمن معلومات غير تقليدية بالإفصاح عن المعلومات المتعلقة بالاستدامة. وتضمن الجوانب البيئية والاجتماعية في التقارير المالية عن طريق توسيع أنظمة التقارير المالية وغير المالية التي تقدمها الشركات والتي يمكن أن تدعم ثقة أصحاب المصالح بالشركة واستمراريتها (Hardiningsih et al., 2020).

الاطار التطبيقي

1. نتائج التحليل التطبيقي

قياس مستوى الإفصاح عن المعلومات المالية المتعلقة بالاستدامة وفق المعيار IFRS S1

سيتم في هذا الجزء بيان مدى تطبيق متطلبات المعيار IFRS S1. وقياس واقع الإفصاح عن المعلومات المالية المتعلقة بالاستدامة، في المصارف العراقية الاسلامية عينة البحث. وقد وقع الاختيار على المصارف الاسلامية باعتبار ان هذه البنوك تحمل في مبادئها مايمكن ان تحقق التنمية المستدامة وتلتزم بكل القيم الاخلاقية، وتسعى الى تصحيح وظيفة المال في المجتمع. وتلتزم المصارف العراقية الاسلامية باعداد قوائمها المالية وفقاً لمعايير هيئة المحاسبة والمراجعة للمؤسسات المالية الاسلامية والمعايير الدولية لاعداد التقارير المالية. كما تلتزم بتطبيق معايير الإبلاغ المالي الدولية استناداً الى تعليمات البنك المركزي العراقي والذي الزم بتطبيقها اعتباراً من سنة (2016). والجدول (1) يبين المصارف عينة البحث كالآتي:

الجدول 1. المصارف الاسلامية عينة البحث

ت	اسم المصرف	الرمز	راس المال / مليار	الاسهم المدرجة	سعر الاغلاق	القيمة السوقية
1	المصرف الدولي الاسلامي	BINT	260,846	160847	1.700	273438
2	مصرف الوطني الاسلامي	BNAI	250	2501000	1.000	251000
3	مصرف كوردستان الدولي الاسلامي	BKUI	400	400000	1.250	500000
4	مصرف جيهان الاسلامي	BCIH	255	255000	2.290	583950
5	المصرف العراقي الاسلامي	BIIB	250	250000	0.500	125000

ولغرض قياس مستوى افصاح المصارف عن المعلومات المالية المتعلقة بالاستدامة وفقاً لمتطلبات معيار الإبلاغ الدولي (IFRS-S1) في تقارير المصارف عينة البحث. تم تحليل التقارير السنوية لسنة (2022) والمنشورة على الموقع الرسمي لسوق العراق للاوراق المالية، وقد تم تناول هذه المتطلبات وفقاً لتصنيف المعيار المذكور، مقسمة الى اربعة ابعاد هي (الحوكمة GOV، الاستراتيجية STR، ادارة المخاطر RSK، المقاييس والاهداف MTR)، وقد تم اعداد استمارة فحص من قبل الباحثة استناداً الى متطلبات المعيار (IFRS, 2023) ودراسة (Pratama et al., 2022) وكالآتي:

المصارف عينة البحث					المتطلبات الخاصة بكل بعد	ت	ابعاد المعيار
BIIB	BCIH	BKUI	BNA I	BINT			
2	2	2	2	2	تحديد صلاحيات مجلس الادارة وصلاحيات لجنة ادارة المخاطر.	1	الحوكمة GOV
2	2	2	2	2	تشكيل لجان مراقبة وادارة المخاطر المتعلقة بالاستدامة.	2	
0	2	2	2	2	توفر الخبرة والكفاءة لادارة استراتيجيات الاستجابة للمخاطر والفرص المتعلقة بالاستدامة.	3	
1	2	2	2	2	وجود تقارير متعلقة بالمخاطر وفرص الاستدامة	4	
2	2	2	2	2	التنسيق والارتباط بين سياسات الادارة وتقارير لجنة ادارة المخاطر.	5	
0	2	2	2	2	مدى وجود مقاييس لتقييم الاداء عن المخاطر ذات الصلة بالاستدامة.	6	
2	2	2	2	2	اجراءات تقييم لجنة ادارة المخاطر وتقييم اجراءات الادارة.	7	
2	2	2	2	2	مسؤولية الادارة في تقييم وإدارة المخاطر والفرص المتعلقة بالاستدامة.	8	
11	16	16	16	16	المجموع		
%69	100 %	100 %	100 %	100 %	نسبة الافصاح عن متطلبات بعد الحوكمة		
2	2	2	2	2	الافصاح عن استراتيجية المصرف في مواجهة المخاطر.	1	الاستراتيجية STR
1	2	2	2	2	مرونة إستراتيجية المصرف في مواجهة المخاطر وتعدد سيناريواتها.	2	
0	0	0	0	0	وصف آثار المخاطر على قيمة المصرف وسلسلة القيمة.	3	
1	0	1	1	2	تأثير المخاطر والفرص المتعلقة بالاستدامة على نموذج الاعمال والتدفقات النقدية.	4	
1	1	1	2	1	توقعات الادارة للتغيرات في المركز المالي للمصرف (خطط الاستثمار، مصادر التمويل) بما يتماشى مع استراتيجيتها للمخاطر والفرص المتعلقة بالاستدامة.	5	
1	1	1	1	1	تضمن المخاطر والفرص المتعلقة بالاستدامة في اتخاذ قرارات التخطيط المالي للشركة.	6	
1	1	1	2	1	البدائل بين المخاطر والفرص المتعلقة بالاستدامة التي أخذتها الإدارة في الاعتبار عند اتخاذ قراراتها.	7	
1	0	0	1	1	معلومات كمية ونوعية حول التقدم المحرز في الخطط التي تم الافصاح عنها في الفترات المالية السابقة.	8	
8	7	8	11	10	المجموع		
%50	%44	%50	%69	%63	نسبة الافصاح عن متطلبات بعد الاستراتيجية		
1	1	2	2	2	تأثير المخاطر والفرص المتعلقة بالاستدامة على استراتيجية الإدارة واتخاذ القرارات.	1	ادارة المخاطر RSK
0	0	0	0	0	اولوية المخاطر المتعلقة بالاستدامة بالنسبة لأنواع المخاطر الأخرى ، بما في ذلك استخدام أدوات تقييم المخاطر.	2	
2	2	2	2	2	مستوى الالتزام بمتطلبات الحكومة للافصاح عن المخاطر.	3	
0	0	0	0	0	تحديد الآثار الزمنية للمخاطر في المستقبل.	4	

1	1	1	1	0	5	الأثار المالية للقرارات المتخذة للتصدي للمخاطر.
1	1	1	1	0	6	تحديد البدائل لتجنب المخاطر ذات الصلة بالاستدامة.
2	1	2	2	1	7	الافصاح عن المخاطر واثرها على المركز المالي واداء المصرف.
1	0	1	0	1	8	العملية التي يقوم المصرف من خلالها بتقييم أهمية المخاطر المتعلقة بالاستدامة.
8	6	9	8	6	المجموع	
%50	%38	%56	%50	%38	نسبة الافصاح عن متطلبات بعد إدارة المخاطر	
1	1	2	2	2	1	معلومات عن السياسات المتبعة لرصد المخاطر المتعلقة بالاستدامة.
1	1	1	1	1	2	مدى دمج عمليات تقييم وإدارة المخاطر المتعلقة بالاستدامة في عملية إدارة المخاطر الشاملة .
1	1	1	1	1	3	مدى الالتزام بالمساهمات المجتمعية للتنمية المستدامة
1	1	2	2	2	4	مؤشرات أداء رئيسية تستخدمها لجنة الحوكمة لقياس التقدم المحرز نحو الأهداف المحددة.
1	1	1	1	0	5	الأهداف التي حددتها الإدارة للتخفيف من المخاطر المتعلقة بالاستدامة أو التكيف معها أو تعزيز الفرص المتعلقة بالاستدامة.
1	1	1	1	1	6	الاهداف المتحققة من مبادرات الاستدامة واطارها الزمني ومدى التقدم .
1	1	1	1	1	7	مقاييس ومؤشرات الاداء المستخدمة لتقييم التقدم نحو الاهداف الاستراتيجية المتعلقة بالاستدامة.
1	0	1	2	1	8	اداء المنشأة مقابل الاهداف المعلنة والتغيرات الهامة في الاداء.
8	7	10	10	9	المجموع	
%55	%44	%63	%63	%56	نسبة الافصاح عن متطلبات بعد المقاييس والاهداف	
35	36	43	45	41	مجموع مستوى الافصاح الكلي	
%55	%56	%67	%70	%64	نسبة الافصاح عن متطلبات المعيار (IFRS S1)	

جدول 2. مستوى الافصاح عن المعلومات المالية المتعلقة بالاستدامة في تقارير المصارف العراقية وفقاً لمتطلبات المعيار IFRS S1*

يوضح الجدول (2) مستوى افصاح المصارف الاسلامية (عينة البحث) عن المعلومات المالية المتعلقة بالاستدامة ومطابقتها لمتطلبات المعيار الدولي للتقارير المالية (IFRS-S1)، بالاعتماد على التقارير المالية السنوية لعينة البحث. حيث تم اعطاء 3 تقييمات لمستوى الافصاح والتي تقيس ايضاً جودة الافصاح (افصاح تام (2) ، إفصاح جزئي (1)، عدم الافصاح (0))، يلي ذلك استخراج نسبة الافصاح عن متطلبات المعيار من خلال المعادلة الآتية:

$$\text{نسبة افصاح المصرف} / \text{اجمالي متطلبات المعيار} \times 100\%$$

يتبين من الجدول اعلاه وجود تباين في جودة الافصاح للمصارف العراقية عينة البحث عن المعلومات المالية المتعلقة بالمخاطر والفرص ذات الصلة بالاستدامة وفقاً لمعيار الابلاغ (IFRS-S1) في تقاريرها المالية السنوية. وكان اكثر الابعاد التي تم الافصاح عنها بشكل تام من قبل المصارف هو بعد الحوكمة (GOV) بمستوى افصاح 100 % عدا المصرف العراقي الاسلامي والذي كان افصاحه افصاحاً جزئياً بنسبة (69%)، على الرغم من الزام البنك المركزي العراقي جميع المصارف العاملة بالعراق بتطبيق قواعد الحوكمة المؤسسية.

* المصدر: من اعداد الباحثة استناداً الى IFRS, 2023

في حين حقق بعد الاستراتيجية (STR) في مواجهة المخاطر المتعلقة بالاستدامة مستوى افصح متباين جداً تراوح بين (44%-69%) حيث تباين مستوى الافصح عن تضمين المخاطر والفرص المتعلقة بالاستدامة في اتخاذ قرارات التخطيط المالي للشركة. كما لم تفصح عينة البحث كلياً عن استراتيجيتها في مواجهة المخاطر والفرص المتعلقة بالاستدامة في تقاريرها السنوية. او سيناريوهات التصدي للمخاطر بشكل كامل. ولم تقدم معلومات مالية عن آثار المخاطر على قيمة المصرف وسلسلة القيمة.

وكان اقل الابعاد تطبيقاً في مصارف العينة البعد الثالث (RSK)، اذ تراوحت نسبة الافصح عن المعلومات المالية لبعد ادارة المخاطر (38%-50%)، وهي اقل نسبة إفصح مقارنة ببقية الابعاد، وعلى مستوى جميع المصارف، وكان المتوقع ان تحقق المصارف العراقية فيه التزاماً تاماً نتيجة طبيعة عمل المؤسسات المصرفية والمخاطر التي تتعرض لها نتيجة انشطتها. رغم التأكيد على اهمية ادارة المخاطر ضمن مبادئ الحوكمة المؤسسية وتوجيهات البنك المركزي العراقي. كما تبين وجود ضعف في وضع اولوية للمخاطر المتعلقة بالاستدامة بالنسبة لأنواع المخاطر الأخرى، وعدم استخدام أدوات لتقييم تلك المخاطر. كما لم تحدد المصارف الآثار الزمنية المستقبلية للمخاطر على قيمة الشركة واصولها.

اما عن بُعد مقاييس وأهداف الكيان (MTR) فقد كانت عملية قياسها اصعب. وقد تباين مستوى افصح المصارف عنه وتراوح بين (44%-63%). اذ لوحظ وجود ضعف في الإبلاغ عن الأهداف التي حددتها الإدارة للتخفيف من المخاطر المتعلقة بالاستدامة أو التكيف معها أو تعزيز الفرص المتعلقة بالاستدامة. كما اشترت تقارير المصارف لسنة (2022) عن عدم وجود ايضاحات تخص الاهداف المتحققة من مبادرات الاستدامة واطارها الزمني، ومدى التقدم المحرز.

من النتائج السابقة فان مستوى الافصح الكلي عن المعلومات المالية المتعلقة بالمخاطر والفرص المتاحة ذات الصلة بالاستدامة وفقاً لمتطلبات المعيار الدولي (IFRS-S1) للمصارف الاسلامية عينة البحث، تراوح بين (55%-70%). ويعود ذلك الى التعليمات والتشريعات الملزمة للقطاع المصرفي منذ سنة (2016) من قبل البنك المركزي العراقي وهيئة المحاسبة والمراجعة للمؤسسات المالية والاسلامية والهيئات التشريعية الاخرى، التي الزمت هذا القطاع على تقديم تقاريره وفق المعايير الدولية للإبلاغ المالي ومعايير المحاسبة الدولية وهو ما يثبت صحة الفرضية الاولى للبحث التي مفادها (تتضمن التقارير السنوية للمصارف العراقية الاسلامية افصاحات كافية عن المعلومات المالية ذات العلاقة بالاستدامة وفقاً لمتطلبات المعيار الدولي (IFRS-S1)).

نتائج تحليل أداء الشركة (PBT)

لغرض قياس الأداء في المصارف الاسلامية عينة البحث واهميتها للمستثمرين واصحاب المصالح. سيتم استخدام أنموذج رياضي مطور من قبل الباحثة، والذي تم تكييفه وفقاً للبيئة العراقية. والمستند الى دراسة كل من (Lopez et al., 2007)(Ameer& Othman, 2012)(Roberts& Dowling,2022)(Grag, 2015) (Laskar& Maji, 2016). ويتضمن النموذج عدة معلمات، (ROA) يستخدم العائد على الأصول في التمويل كمقياس للعوائد التي تحققها الشركة من رأسمالها الموظف. ويستخدم عادة كمقياس لمقارنة الأداء بين الشركات وتقييم ما إذا كانت الأعمال التجارية تولد عوائد كافية لدفع تكلفة رأس المال. كما يؤثر حجم الشركة على أدائها، ويتم حساب (SIZE) من خلال اللوغارتم الطبيعي للقيمة السوقية كمتغير للتحكم باداء الشركة، اما (RISK) فان الشركات المربحة تستخدم ديون أقل بسبب مصادرها الداخلية الكافية لتمويل الاستثمار، يتم استخدام نسبة الدين إلى الاصول كمقياس للرافعة المالية.

$$PBT_t = \beta_0 + \beta_1 SIZE_t + \beta_2 ROA_t + \beta_3 RISK_t$$

1. PBT: الربح قبل الضريبة
2. β_1 Size: حجم الشركة ويقاس بـ (log of the Market value) لوغارتم القيمة السوقية للشركة
3. β_2 ROA: معدل العائد على الاصول = الدخل قبل الضرائب / اجمالي الاصول
4. β_3 RISK: الرافعة المالية = اجمالي الديون / اجمالي الاصول.

PBT	RISK	ROA	SIZE	رمز المصرف
7.142	0.560	0.022	5.436	BINT
9.110	0.518	0.002	5.399	BNAI
6.188	0.563	0.043	5.698	BKUI
7.013	0.392	0.080	5.766	BCIH

جدول 3. نتائج احتساب أنموذج PBT لعينة البحث

لمعرفة تأثير معالم الانموذج الرياضي على أداء الشركة نستخدام الانحدار المتعدد عبر استخدام البرنامج الاحصائي SPSS

كما في الجدول (4)

Sig	F	R ²	R	Sig	t	Std. Error	β	
				.049	12.879	1.502	19.346	Constant
0.118	38.473	0.991	0.996	.581	-0.773	0.324	-0.251	Size
				.063	-10.127	5.130	-51.956	ROA
				.081	-7.834	2.178	-17.060	RSK

جدول رقم 4. نتائج تحليل الانحدار المتعدد : باستخدام PBT كمتغير لاداء الشركة

الجدول (5) يبين تقدير PBT لغرض اخضاعها لاختبار أثر جودة الافصاح كمتغير مستقل

^	^	^	^	الثابت â	رمز المصرف
PBT	RISK	ROA	SIZE		
7.304	- 9.553	- 1.143	- 1.364	19.346	BINT
7.651	- 8.837	- 1.503	- 1.355	19.346	BNAI
6.078	- 9.604	- 2.234	- 1.430	19.346	BKUI
7.056	- 6.687	- 4.156	- 1.447	19.346	BCIH
7.417	- 0.562	- 10.339	- 1.028	19.346	BIIB

جدول رقم 5. نتائج تقدير PBT كمتغير لاداء الشركة

2. مناقشة نتائج الاختبار

يتناول هذا الجزء مناقشة نتائج الاختبار التطبيقي لأثر جودة الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفقاً لمتطلبات المعيار الدولي (IFRS-S1) على أداء المصارف عينة البحث. أي تأثير ابعاد جودة الافصاح عن المعلومات المالية وفق

* تم احتساب اللوغارتم الطبيعي ل PBT ونتائج حساب اللوغارتم تمثل قيم المتغير المستقل.
 † المصدر: من اعداد الباحثة استنادا الى برنامج SPSS

معييار S1 IFRS (MTR, RSK, STR, GOV) في PBT. باستخدام أنموذج الانحدار باستخدام برنامج SPSS لتحديد اتجاه الأثر وكما يظهر في الجدول (6)

^ PBT							X ابعاد جودة الافصاح
Sig	F	R ²	Sig	t	Stad. Error	β	
0.546	1.356	0.802	0.188	3.285	2.884	9.477	Constant
			0.409	-1.332	2.112	-2.815	GOV
			0.365	1.545	2.733	4.225	STR
			0.400	6.553	2.002	1.034	RSK
			0.380	-1.275	3.493	-4.456	MTR

المصدر: من اعداد الباحثة استنادا الى برنامج SPSS

جدول رقم 6. نتائج تحليل الانحدار المتعدد لابعاد جودة الافصاح وفقاً لمعييار S1 IFRS و PBT^

* قيمة t الجدولية (2.132) عند مستوى الدلالة (0.05) ودرجة حرية (4) .
** قيمة F الجدولية (7.71) عند مستوى دلالة (0.05) ودرجة حرية (4) .

ويكشف الجدول (6) ان قيمة R² بلغت (0.802) بمعنى ان جودة الافصاح عن المعلومات المالية قادرة على تفسير 80% من التباين الذي يطرأ على PBT . الا ان هذا التأثير غير معنوي كما تشير لذلك قيمة F المحسوبة التي بلغت (1.353) وهي اصغر من قيمتها الجدولية عند مستوى دلالة (0.05) ودرجة حرية (4). اما عن دلائل معاملات الانحدار (β) الذي يظهر العلاقة الخطية بين متغيرات البحث. فقد كانت طردية لبعدي (RSK, STR) وعكسية بالنسبة لبعدي المقاييس والاهداف (GOV, MTR). ولكن لم تثبت معنوية معامل بيتا إذ كانت قيم (t) المحسوبة للابعاد اصغر من قيمها الجدولية عند مستوى دلالة (0.05) مما يشير الى ان العلاقة غير دالة معنوياً. ويستدل من هذه النتائج الى رفض الفرضية البديلة الثانية للبحث والتي مفادها (يوجد تأثير ذو دلالة معنوية لجودة الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفقاً لمتطلبات المعييار الدولي (IFRS-S1) على أداء الشركة). وقبول الفرضية الصفرية . ويمكن تفسير ذلك الى ان الافصاحات عن المعلومات المالية المتعلقة بمعييار IFRS-S1 كانت جزئية وضعيفة لبعض الابعاد مما اثر سلباً على المتغير التابع (أداء الشركة) الممثل بـ (PBT). كما يمكن ان يستدل من النتائج الى ان الافصاح عن معلومات الاستدامة الخاصة بشركة ما قد تؤثر سلباً على أدائها على المدى القصير وإيجابياً على المدى الطويل، وتتفق هذه النتائج مع دراسة كل من (Lopez et al., 2007) (Yang, 2010) ولكنها لا تتفق مع دراسة (Gang, 2015) (Ameer & Othman, 2011).

واستناداً الى ماجاء بالجدول اعلاه يمكن الحصول على معادلة الانحدار المتعدد باستخدام Beta غير المعيارية .

$$PBT = 9.477 + (- 2.815)GOV + 4.225 STR + 1.034 RSK + (- 4.456)MTR + \epsilon$$

الاستنتاجات

- 1- تلتزم المصارف الاسلامية عينة البحث بشكل جزئي بالافصاح عن المعلومات المالية المتعلقة بالاستدامة وفق متطلبات المعيار IFRS S1 ولكن ليس بالشكل الذي يكفي لتحسين اداء المصارف. وقد تباين بين الافصاح التام لبعدها الحوكمة (GOV) والضعيف بالنسبة لبعدها ادارة المخاطر (RSK). وان الزام المصارف العراقية بالالتزام بمعايير الابلاغ المالي IFRS اعتباراً من عام 2016 من قبل الهيئات الحكومية قد عزز من افصاح المصارف عينة البحث.
- 2- وجود قصور في الافصاح عن بعض المعلومات المالية الاساسية خاصة فيما يتعلق بادارة مخاطر المصارف المتعلقة بالاستدامة، في تقرير الادارة السنوي للمصارف عينة البحث. خاصة مايتعلق منها بالآثار المالية للمخاطر في المستقبل.
- 3- يتطلب الافصاح عن معلومات الاستدامة التي من الممكن ان تعزز اداء الشركات وقتاً ليس بالقصير لتظهر آثاره جلية في تحسين اداء الشركات.
- 4- يعد مفهوم ممارسة الإبلاغ عن الاستدامة جديداً في العراق نوعاً ما ولا يزال يتطور-ضعيف ، وقد بدأت بعض المصارف في إعداد تقارير استدامة من عام 2018 فصاعداً ولكنها لاتزال شكلية ولا تلبى احتياجات اصحاب المصلحة والمستثمرين.
- 5- في حدود البيانات المالية ونتائج التحليل المترتبة عليها لم يتم اثبات الفرضية الثانية للبحث وهذه النتائج تتفق مع دراسي (Lopez et al., 2007) (Yang, 2010).

التوصيات

- 1- يمكن للحكومة أن تلعب دوراً هاماً جداً في تعزيز ممارسات الاستدامة، عن طريق التشريع أو عن طريق الهيئات المالية. وحث البنك المركزي على اهمية البدء باعداد التعليمات المالية الخاصة بالافصاح عن الاستدامة، ومنها متطلبات الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفق متطلبات المعيار IFRS S1.
- 2- يتطلب اصدار تعليمات ملزمة من قبل الجهات الحكومية والمالية . لنشر مفهوم الاستدامة وبما يساهم من تحسين اداء الشركات على المدى الطويل وبما يعزز سمعة الشركة وثقة المجتمع. إذ ان الآثار السلبية قصيرة المدى قد تمنع الشركات من تبني ممارسات الاستدامة.
- 3- يعد تطبيق متطلبات الافصاح عن المعلومات المالية المتعلقة بالاستدامة وفق معيار الافصاح IFRS S1. مهم جداً بالنسبة للقطاع المصرفي بسبب طبيعة عمل هذا القطاع والمخاطر التي يتعرض لها وبما يساهم في ادارة المخاطر المصرفية وترشيد القرارات التي يتخذها المصرف.

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Using Silver Nanoparticles to Increase Some Glycosidic Compounds of *Stevia Rebaudiana* in Vitro

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Abstract

This experiment was objected to increase some Glycosides active compounds production in *Stevia rebaudiana* seedlings through plant seeds treatment with different concentrations of silver nanoparticles that diagnosed and characterized using AFM technique. This research was implemented at plant tissue culture laboratory of College of biotechnology - Al Nahrain University, throughout the period of 2022 and 2023. The experiment designed factorial within CRD using three expermentse and ten replicates. Sodium hypochlorite concentration (S1, S2, S3, S4) (0.0, 1, 2, 3%) represented the first experment, treatment duration time (T1, T2, T3) (5, 10, 15min) represented experiment 2, silver nanoparticles concentrations (C1, C2, C3, C4) (0, 10, 20, 30 mg.l-1) in MS media, represented experiment 3. Results showed that the contamination rate of the selected *S. rebaudiana* explant reduced and registered at at 10 and 15min in 3% sodium hypochlorite. The results also showed that there were a significant increase in the shoots numbers in 30 mg.l-1 AgNPs that reach the highest in terms of shoots numbers, the significant increasing of shoot length within the 10 mg.l-1 enrolment 14.5cm then decreased in both concentrations 20, 30 mg.l-1, seedlings dry weight significantly raised up to 20 mg.l-1, while the seedlings dry weight also significantly dropped in 30 mg.l-1 AgNPs., all the analyzed Glycosides compounds using HPLC device as Rubsosite, Dulcoside, Stevioside concentrations were significantly increased in 20 and 30 mg.l-1 AgNPs, in comparsion to the control.

Key Words *Tissue Culture ; Nanotechnology ; Secondary Metabolite ; Glycosides ; Stevia Rebaudiana*

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Introduction

Stevia rebaudiana has a sweet leaves taste that stays in the mouth for hours due to the spread of sweet ingredients in the leaf. While bitter-tasting substances are concentrated around the veins, also contain biologically active plant chemicals that work to maintain the various physiological functions of the human body (Ahsan, et al. 2020). Diterpene glycosides are responsible for the high sweetening potential of the leaves. Most of the available stevia glycosides are stevioside and dulcoside, dulcoside, represents 4 to 13% of all glycosides found in stevia, and the leaves are bitter when tasted. Analysis showed that pure stevioside is 300 times sweeter than sucrose at a concentration of 0.4% (Ahsan, et al. 2020). Stevia is belonging to the Asteraceae family and it has self-incompatibility that plant is a perennial herbaceous plant originating from South America and is currently grown in several regions of the world, Asia, North America, and Europe (Ghose, et al. 2022). Japan was the first country to grow and market Stevia as an alternative to sucrose, followed by China, Malaysia, South Korea, Taiwan and Thailand to market it (Paucar, et al. 2023). Economically Agriculture can be defined as a backbone of developing countries economy, since more than 60% of the world's population count on it for their life. nanotechnology has the potential to revolutionize the food industry and agricultural with new tools for diseases control (Wheeler 2008). It is possible to increase the production of secondary compounds in plants in light of the technology of culturing plant tissues and organs, and using the capabilities of certain methods, such as controlling the components of the nutrient medium of crops and exposing the crops to stress. Stimulation or agitation by exposing cultivated plants to stress factors has always been an important means of increasing the production of specific pharmaceutical compounds in different plants, regardless of whether these stimulants are Biotic or Abiotic (Mastuti and Rosyidah, 2019). bacteria attacking canned stored foods, nanotechnology was used to control these bacteria, thus preserving foods for a longer period (Pena et al.2020).

Nanoparticles are considered as one the important source on which modern scientific researches in several scientific specifications are based. This may be due to the characteristics that these small materials have in terms of size and shape and surface, beside its distribution. This type of experiments (which is depending on nanomaterials and their applications) is growing, quickly, a number of authors were activated in plant tissue culture that based on the use of nanotechnology in seed germination, plant growth enhancement, crops protection, as well as secondary metabolism enhancement (Parzymies ,et al. 2019 & Pour,et al.2019) a research was conducted to check the impact of silver nanomaterials combined with growth regulators, the combination was carried out between 10 mg L^{-1} Ag NPs, 2.5 mg L^{-1} BA, and 0.1 mg L^{-1} IAA added to the MS nutrient medium in plantations of the farfar plant or *Tecomella undulata*, the highest formed branches number, plant parts % that produced new branches, plants fresh weight and resulting plants number. This may be due to the impact of the tested combination in ethylene production reducing. The Author also confirms that the treatment of Nano

silver with 60 mg. L^{-1} had clearly reduced branches growth, indicating the stimulating effect was reversed to an inhibitor at the high concentrations of the Nano silver treatment (Aghdaei, et al. 2012). Among the scientist attempts recorded the increasing of secondary metabolites in plants, the content of vanilla plant *Vanilla planifolia* increased when nano-silver was added to the MS medium, which was nourished with total phenols and glycosidic compounds due to increased production of ROS (Reactive oxygen species) at concentrations of (25 and 50) mg. L^{-1} (Santoscoy , et al. 2017). In a study by (Javed 2017) when growing the sugar leaf plant *Stevia rebaudiana* outside the living body to check the impact of different concentrations of nano-zinc oxide (0, 0.1, 1.0, 10, 100, and 1000 mg.L^{-1}) in the absence of traditional growth regulators on the production of Secondary compounds, as the results showed superiority to the treatment of 1 mg. L^{-1} of nano-copper oxide increased the production of flavonoids and total phenols, while all studied indicators decreased with increasing concentration of nano-copper oxide (Samy et al. 2019) also indicated their success in using silver nanomaterial produced from the herb extract as an alternative to fungicides to control some bacterial and fungal infections affecting potatoes. Silver nanoparticles can act as a catalyst to produce more copies of the genes of the steviol glycoside biosynthesis pathway, thus increasing the production of this compound Between (Ramezani et. al 2019).

The silver nanoparticle also increased at a concentration of 5 mg. L^{-1} with a size of 48 nanometers of *Chrysanthemum* flower growth and an increase in anthocyanins and carotene In vitro (Tymoszuk and Kulus, 2020). In a tissue culture experiment of the olive plant *Olea europaea* objected to increase the secondary compounds (glycosides), different concentrations of Nano silver nitrate (0, 0.5, 1, 1.5, 2) mg. L^{-1} were added to the MS nutrient medium. HPLC results showed that adding 2 mg. L^{-1} caused a significant increase in all steroidal compounds studied compared to the mother plant (AL-Sowaidi and AL- Oubaidi, 2015).

Materials and methods

1. **Nutritional Environment:** Nutrient medium (MS) (Murashige and Skoog, 1962) with a weight of 4.91 g. L^{-1} was used, The product is from the Indian company Himedia, and 25 g. L^{-1} of sucrose are added to it and the nanoelements According to the experiment, the pH was adjusted to 5.8. The volume was completed to one liter, after which agar (Agar-Agar) was added at a rate of 8 g. L^{-1} of nutrient medium, placed on a hot plate magnetic stirrer at a temperature of $90\text{-}100 \text{ }^{\circ}\text{C}$, and the nutrient medium was distributed in the tubes at a rate of 10 ml for each tube, then they were sterilized with an autoclave at a temperature of $121 \text{ }^{\circ}\text{C}$ and a pressure of 1.04 kg. cm^{-2} for 15 minutes, then leave the medium to cool and solidify at room temperature until it is ready for cultivation.

- 2. Silver Nanoparticles Solution and Detection Preparation:** The first step started by dissolving Nano Ag 100 mg in double distilled water 1000 ml, step two was stirring through a hot plate magnetic stirrer continuously to guarantee the solubility of the solution, third step was to prepare Nano Ag solution by using an ultrasonic probe for 15min an ultrasonic probe was used, the frequency of the ultrasonic probe was 60Hz, to guarantee the dispersion and disintegration of the Nano silver and did not agglomerate then bring them to their normal size a small drop placed of the tested samples on a glass slide, step four was left the samples at the room temperature. An (AFM) Atomic Force Microscope type Angstrom Advanced (AA) 2000The was used to test the drying sample of Nano Ag, (Oraibi, et al.2023). Silver nanoparticles (AgNPs) was imported from Sigma Aldrich Company.
- 3. Nano Silver Concentrations Preparation:** Several doses or concentrations of nanomaterial prepared for dissolving and dilution (0, 10, 20 and 30mg,L⁻¹) using sterilized distilled water, at the room temperature prepared concentrations was kept in vials under dark environment for using it in seed germination test in the next steps.
- 4. Extraction Of Secondary Metabolites From Vegetative Growths:** The vegetative growths of the treatments were taken and washed with water, then dried in a laboratory oven at a temperature of 45°C for 72 hours and crushed in preparation for the extraction stage. 3 g of the dry matter was dissolved in 25 ml of 70% ethanol in the dark at room temperature and placed in Soxhlet extractor device for a period of 4 hours. Filter the dissolved extract to obtain a clear, impurity-free liquid. Transfer the extract to the Rotary evaporator device to concentrate the extract. Then dry the extract in the laboratory oven. Then record the final weight of the viscous substance resulting from the drying process for each sample. Thus, the crude extract is ready.

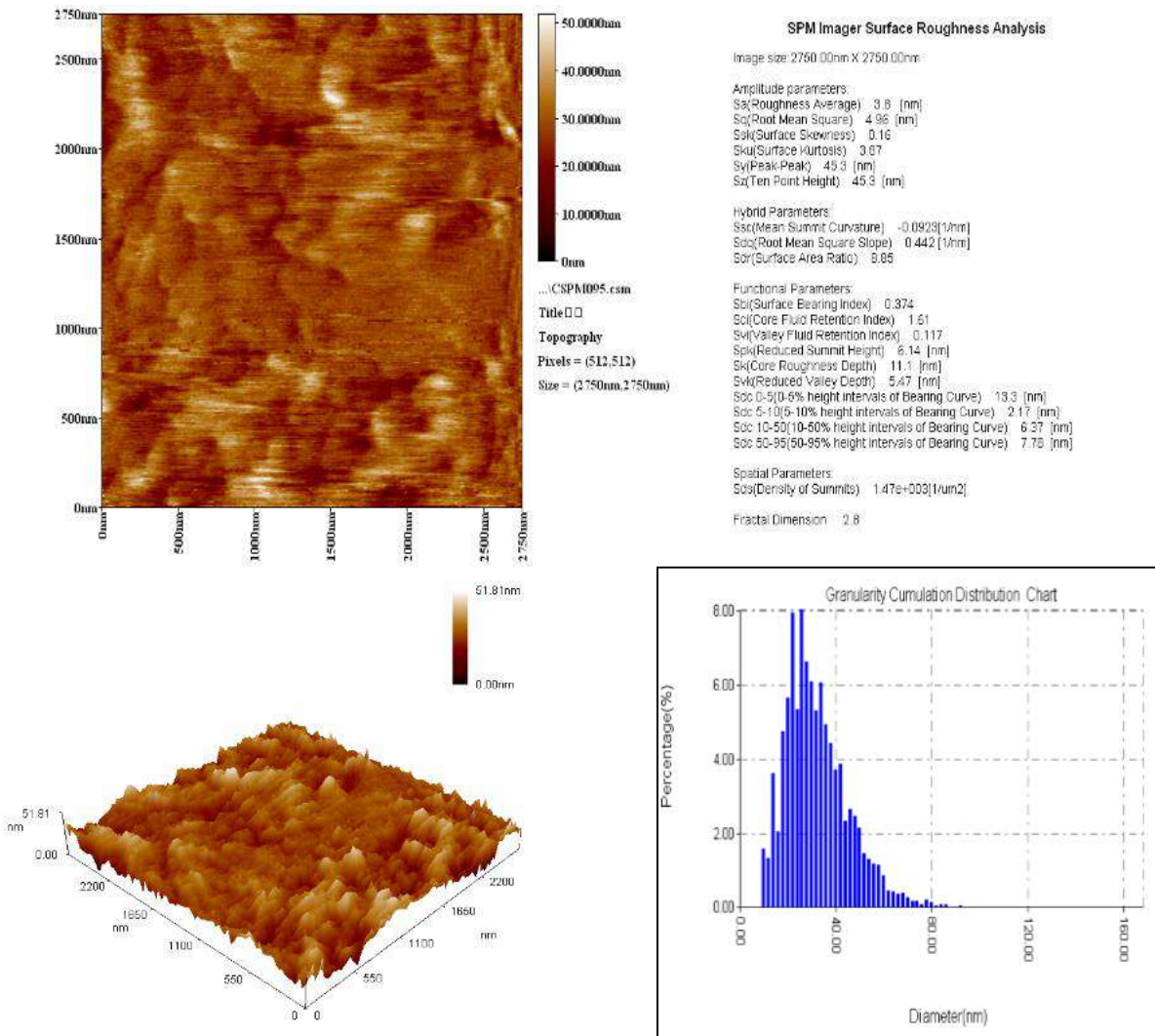
Statistical Analysis and Experimental Design

The statistical software Genstat was used to test the collected data under factorial, Completely Randomized Design (CRD), using 10 replicates of each treatment ($p=0.05$).

Results and discussion

Figure 1 that the Microscope (AFM) which gauge the particle size surface topography, diameter and roughness of silver nanoparticles. silver images of the surface topography show the size of the silver nanoparticles is 51.81 nm, the same image also indicate a homogeneous tested nanoparticle on the surface. Another observation was shown that the RMS surface roughness of the silver nanoparticles the medium diameter of the silver particles was 31.22 nm and 4.96 nm. These results were concurrent with those gained by (Oraibi, et al.2023) who discussed The analysis using the (AFM) which also was used in several researches to check the surface characteristic,

Figure 1. Three dimensional image of the surface morphology for AgNPs using AFM.



Surface roughness and size of nanoparticles of (AgNPs). three- Two -dimensional photo of all tested nanoparticles showed that the uniform shape and regular and size.

Table 1 reflect a contamination mean significantly decreased in *Stevia rebaudiana* seeds contamination mean at 1, 2 and 3% concentrations , sodium hypochlorite enrollment 83, 32 and 3.4 comparing with control which reported 100% contamination rate while lowest frenzy observed in the sodium hypochlorite 3%, results of exposure duration time shows a sterilization significant decrease obtained with the time durations 10,15 min respectively 45.3, 53.6 min comparing with the highest sterilization level which observed in 5 min (69.8). The interaction among the duration time and sodium hypochlorite conc. exhibited that in 3% sodium hypochlorite at 10 and 15min recording 0.0 contamination rate means increasing in the sterilization rate, thus using 3% sodium hypochlorite for 15min to treat *Stevia rebaudiana* seeds could guarantee 100% sterilization through germination period.

Table 1. Different Sodium hypochlorite concentration effects on sterilization of *Stevia rebaudiana* seed after ten days.

Sodium Hypochlorite Concentration %	Tim (Min)			Mean
	5	10	15	
0	100	100	100	100
1	100	83	67	83
2	78.0	32	13	39
3	12.0	0.0	0.0	3.4
L.S.D. (0.05)	3.35			1.93
Mean	69.8	53.6	45.3	
L.S.D. (0.05) time	1.67			

Table 2 and Figure 2 reflect increasing in the shoots numbers character up to 20 mg/l⁻¹ AgNPs which indicate the highest shoots numbers (6.40) hence its decreased in 30 mg/l⁻¹ AgNPs (3.70) . meantime length shoot increased in 10 mg/l⁻¹ achieving 14.5 cm then decreased in 20 and 30 mg/l. thus the seedlings dry weight has enhanced in 20 mg/l AgNPs that reach the the highest dry weight 30.67 mg, thus seedlings dry weight decreased in 30 mg/l⁻¹ AgNPs (18.21mg), results differ from those reported by (Yang et al. 2020).

This could be based on the low concentrations used in the current research work. Also, table 2 observed that as soon as concentration of Nano silver increased, the performance data started to decrease. the reason for the significantly increasing in the shoots number or shoots length, and the stem dry weight is mainly because of the short duration of seeds treatment with AgNPs .

However, characteristics such as the length of root, rate of germination, and biomass was decreased, with Nano Ag uptake increasing, shoots & roots that treated with rising concentrations of AgNPs. It was also observed that silver nanoparticles AgNPs accumulated in chloroplasts inside the plant cells (Gonzalez, et al. 2019).

Table 2. . Shoots number, shoots length, and dry weight effected by Different concentrations of silver nanoparticles on of *S. rebaudiana* after cultivation for four weeks. n=10

Concentrations of AgNPs (mg/l ⁻¹)	Shoots number	Shoots length (cm)	Fresh weight (mg)	Dry weight (mg)
0	2.00	2.2	292.0	19.46
10	4.10	14.5	440.2	36.01
20	6.40	7.1	560.1	30.67
30	3.70	5.2	289.0	18.21
Mean	4.05	7.25	395.3	26.08
L.S.D. (0.05)	1.17	0.29	34.9	2.2

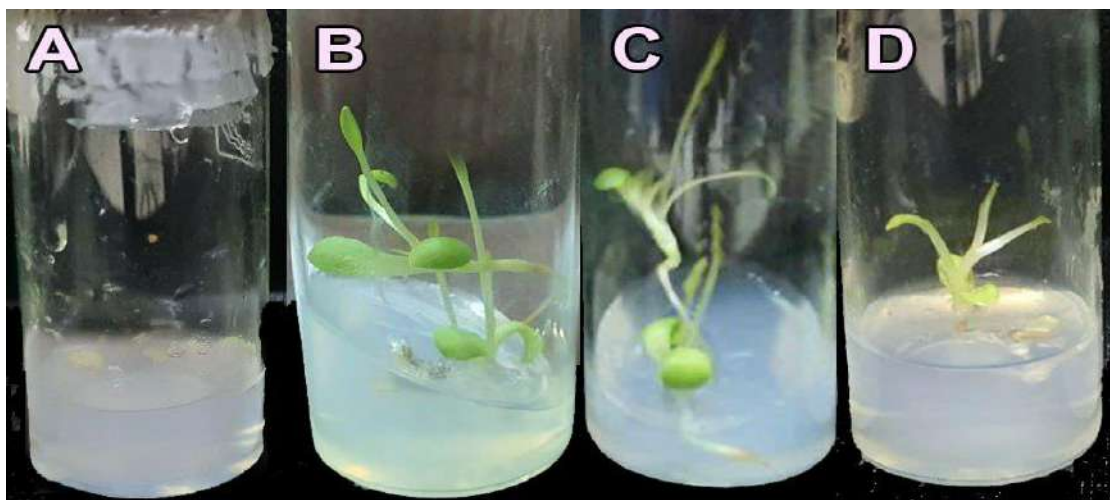


Figure 2. Effect of different concentrations of AgNPs on *S.rebaudiana* growth on MS medium supplemented with A=0.0 mg/l⁻¹, B= 10 mg/l⁻¹, C=20mg/l⁻¹ and D= 30 mg/l⁻¹ AgNPs.

The results in Table 3 exhibited that the highest concentration of the analyzed active compounds in Stevioside that recorded 75.77 $\mu\text{g. g}^{-1}$ compared to Rubsosite and Dulcoside that recorded 19.15, 23.4 $\mu\text{g. g}^{-1}$ respectively. Also, the data shown that there was a significant increase in Stevioside concentrations with the increase of silver nanoparticles concentrations recording 83.23 AgNPs compared to the control 5.86 $\mu\text{g. g}^{-1}$, while the Rubsosite concentration increased significantly in 20 mg. L⁻¹ AgNPs compared to the control and 10 mg. L⁻¹ AgNPs and decreased significantly in 30 mg. L⁻¹ AgNPs recording 19.15 $\mu\text{g. g}^{-1}$. The Dulcoside active compound concentration increased significantly in 10, 20 mg. L⁻¹ AgNPs and decreased significantly in 30 mg. L⁻¹ AgNPs recording 23.4 $\mu\text{g. g}^{-1}$ compared to the control 2.34 $\mu\text{g. g}^{-1}$.

The cultures also showed clear antioxidant, anti-inflammatory, antidiabetic, antifungal, antibacterial and anticancer activities. The use of AgNPs (3 mg/L) also resulted in a nine-fold increase in the yield of GA II and PC compared to unmodified CSC, (Siddiqi et al.2020)

Table 3. Effect of different concentrations of silver nanoparticles (AgNPs) on glycosidic compounds in plantlets, n=10

Concentration of Ag NPs (mg. L ⁻¹)	Stevioside	Dulcoside	Rubsosite
0	5.86	0.05	2.34
10	12.65	7.19	3.97
20	75.77	19.15	23.4
30	83.23	16.51	20.2
Means	44.40	10.72	12.50
L.S.D. 0.05	5.33	3.21	3.97

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Mixed Convection Numerical Study Within Lid-Driven Cavity Heat Transferring with Variable Prandtl Number

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Huda Abdullah Al-Mayahi ²




Abstract

Heat transfer mixed convection for laminar fluid flow within a vented rectangular cavity is numerically studied. The enclosure's upper wall heated to a consistent temperature while the bottom wall is maintained at a steady speed while it remains cold. An opening in the upper left wall of the cavity allows an external flow to enter, and one in the lower left vertical wall of the cavity allows an external flow to exit. The finite element method is used in conjunction with the Flex PDE software package to solve the conservation governing equations for continuity, energy, and momentum. Results from streamlines, isotherms, and the average Nusselt number demonstrate the impact. of Reynolds number ($Re = 20, 50, 80, 100$) Richardson number ($Ri = 1, 6, 10$) and the variable Prandtl number ($Pr = 0.71, 1.7, 50$) for air, water and oil, respectively on heat transfer. The findings indicate that the average Nusselt value rises as Pr and Re grow and falls when Ri number drops. The findings show a good agreement when compared to those of other authors in the literature.

Key Words *Mixed convection ; Free Heating ; Rectangular Enclosure*

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Introduction

In recent years, there has been a lot of interest in the phenomenon of free convection in cavities with different geometries. This is because it has so many important engineering and scientific uses, like in boilers, energy storage, fire suppression, chemical building insulation, solar collectors, nuclear reactor cooling systems, and lake convection processes [1,2]. When temperature gradients within fluids cause buoyancy-induced flows, natural convection develops as a heat transfer mode. A summary was also provided of the results of internal body processes with various geometries (such as circular, square, and elliptical cylinders) on mixed convection heat transfer. Multiple studies on the phenomenon of natural convection within holes with varying boundary conditions have been conducted to satisfy distinct objectives because of the importance of convection-based heat exchange in engineering systems [3]. The review of the literature revealed that the enclosures under study were either filled with liquid water, oil, or air. As a result, the water-filled enclosures are listed first, followed by the air-filled ones. An investigation by Ali et al. [4] looked at a naturally occurring dimensionless heat transfer efficiency inside two square water-filled chambers. Average Nusselt and modified Rayleigh values were calculated for every enclosure. Using the ratio of aspect ($AR = S/H$) and the modified Rayleigh number, specific Each enclosure's correlations were obtained, and the two enclosures' combined correlations were also discovered as follows:

$$Nu = 16.676 (Ra_H^*)^{0.0502} k^{-1.018}, 4 \times 10^6 < Ra_H^* < 3.5 \times 10^8$$

Shobha et al. [5] presented a mixed convection inside a four-sided lid-driven square porous cavity whose right wall is maintained at a sinusoidal temperature condition, the left wall of the cavity is maintained at a cold temperature, while the top and the bottom walls are adiabatic. They discussed numerically two different cases depending upon the direction of the moving walls. They investigated by ranging the various dimensionless numbers such as Grashof number ($10^3 \leq Gra \leq 10^5$), Darcy number ($10^{-1} \leq Dar \leq 10^{-5}$), Reynolds number ($10 \leq Re \leq 1000$) while maintaining the Prandtl number ($Pra = 0.7$) fixed.

Olanrewaju et al. looked studied the effects of aspect ratio, Rayleigh, and Nusselt on flow and heat transmission in rectangular holes. [6]. In accordance with the predicted Nusselt numbers with a Prandtl number of (0.71) at air temperature, they provided variations of stream lines and temperatures, contours, and isotherms of the resulting flow fields. They discovered that heat transmission in rectangular cavities rises at larger Rayleigh numbers of flow. However, the Nusselt number, which was calculated close to the hot wall's edge, showed that convection was the primary method of heat transmission with a greater aspect ratio. They claimed that when aspect ratio grew, the thickness of

the thermal boundary layer also increased continuously, significantly enhancing the amount of fluid heat transfer by convection in the rectangular cavities.

In order to compute the friction of fluid and the spread of entropy produced by the heat move mechanism for Rayleigh numbers ranging from 10^5 to 10^8 and ratios of aspect ranging from 3, 5, 7, and 12, Souda et al. [7] studied the free convection phenomenon using numerical techniques in rectangular holes with different ratios of aspects. It was discovered that the ratios of aspect are significantly influenced by the rate at which Rayleigh numbers grow relative to the generation of all entropy. According to the experimental view, when a cavity is heated at the bottom and cooled at the top, the Rayleigh number increases and the average heat transfer coefficient rises.

Other scholars have examined the natural process of convection of heat transfer for various parameters inside a cavity filled with air [8,9,10]. Not much research has been done on thermally induced flows in triangular cavities with varying aspect ratios in variably warmed vertical walls and adiabatic horizontal walls, notwithstanding the fact that natural convection in cavities has been extensively studied using numerical simulations and experimental methods. This may be partially attributed to the issue's complexity as well as other related problems. It is important to note that research in this field may advance our knowledge and result in better system design and performance, particularly for practical applications like the drying and storage of phenomena. Additionally, it is possible to test for the Navier-Stokes equations in laminar, steady, and incompressible flows using the program validated codes.

The present study's main goals are to show how mixed heating affects mixed convection and how streamlines, isotherms, average temperature, Reynolds number, Prandtl number, and Nusselt number all have an impact.

Theoretic Analysis

A diagram representation of the issue at hand is shown in Figure 1. It is a rectangular, vented enclosure that has a height of W and a base of L . The side walls are adiabatic, the bottom wall is cold and lid driven with constant velocity while the upper wall is heated at constant temperature (T_{e_h}). The enclosure's inflow opening is on the upper left vertical wall, and its exit opening is on the lower right wall. Radiation and the term for viscous dissipation in the energy equation are not taken into account. In non-dimensional form, the equations that govern steady, laminar, two-dimensional, incompressible flow with constant fluid properties and the Boussinseq approximation look like as this [11]:

Equation of continuity

$$\frac{\partial UU}{\partial X} + \frac{\partial VV}{\partial Y} = 0 \quad (1)$$

Equation of momentum in x-direction

$$U \frac{\partial UU}{\partial X} + V \frac{\partial UU}{\partial Y} = -\frac{\partial P^*}{\partial X} + \frac{1}{\text{Re}} \left(\frac{\partial^2 UU}{\partial X^2} + \frac{\partial^2 UU}{\partial Y^2} \right) \quad (2)$$

Equation of momentum in y-direction

$$U \frac{\partial VV}{\partial X} + V \frac{\partial VV}{\partial Y} = -\frac{\partial P^*}{\partial Y} + \frac{1}{\text{Re}} \left(\frac{\partial^2 VV}{\partial X^2} + \frac{\partial^2 VV}{\partial Y^2} \right) + \text{Ric} \theta \quad (3)$$

Equation of energy

$$U \frac{\partial \theta}{\partial X} + V \frac{\partial \theta}{\partial Y} = \frac{1}{\text{Re Pr a}} \left[\frac{\partial^2 \theta}{\partial X^2} + \frac{\partial^2 \theta}{\partial Y^2} \right] \quad (4)$$

The dimensionless variables are defined as:

$$XX = \frac{xx}{L}, \quad YY = \frac{y}{L} y, \quad U = \frac{u}{u_{in}}, \quad V = \frac{v}{u_{in}}, \quad \theta = \frac{Te - Te_{in}}{T_h - Te_{in}}$$

$$P^{**} = \frac{pa}{\rho u_{in}^2}, \quad \text{Pr a} = \frac{\nu}{\alpha}, \quad \text{Ric} = \frac{Gr}{\text{Re}^2}, \quad Gr = \frac{g\beta(Te_h - Te_{in})L^3}{\nu^2} \quad (5)$$

The boundary conditions are:

$UU=1, VV=0$ and $\theta = 0$ at the inlet

$UU=VV=0$ and $\theta = 1$ at the upper wall

$UU=1, VV=0$ and $\theta = 0$ at the bottom wall

$UU=VV=0$ and $\frac{\partial \theta}{\partial N} = 0$ at the other walls of enclosure

$P^{**} = 0$ at the outlet

The average Nusselt number on the wall that is warm is calculated using the following technique: [12]

$$Nu_{av} = \int_0^1 \left(\frac{\partial \theta}{\partial y} \right)_{y=w} dx \quad (6)$$

and the bulk average temperature is defined as:

$$\theta_{av} = \int_0^1 \frac{\theta dv}{\underline{v}} \quad (7)$$

Where \underline{v} : the volume of occupying fluid in rectangular enclosure.

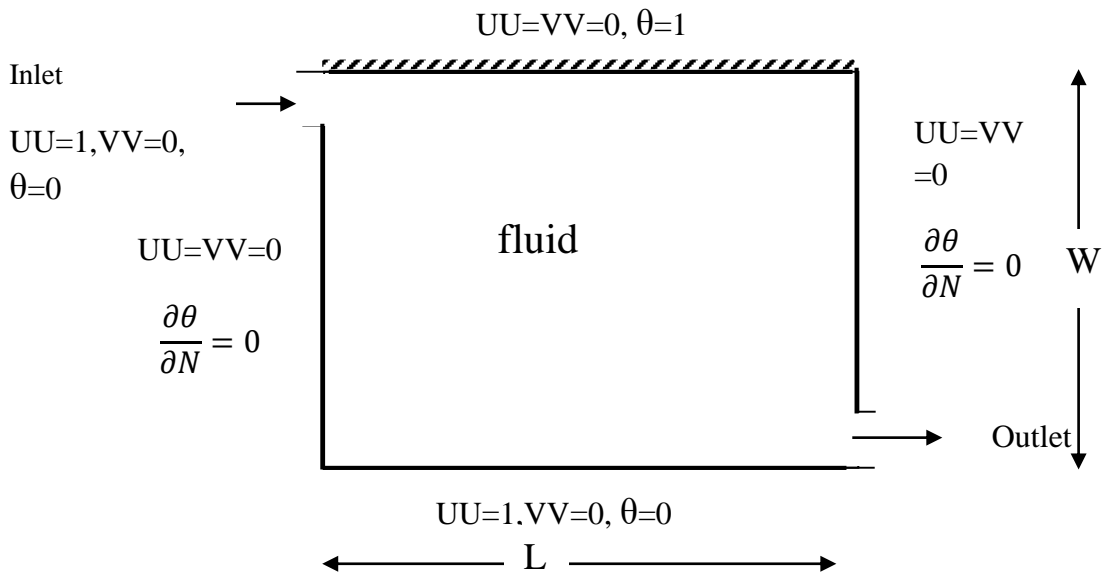


Figure 1. An illustration of the physical model's boundary conditions

Numerical Solution

Using the software program Flex PDE, the finite element method is used to numerically solve the boundary conditions and governing equations (1) to (4) [13]. Due to mass conservation, the equation of continuity (1) must be adopted as a constraint, so this restraint can be employed to determine the pressure distribution [6]. Using a penalty parameter and the equation-based compressibility criterion (1), we can solve equations (3) to (5), yielding:

$$\nabla^2 P = \gamma \left(\frac{\partial uu}{\partial x} + \frac{\partial vv}{\partial y} \right) \tag{8}$$

γ is a penalty parameter that ought to be determined either through other methods or by using physical knowledge [14]. In this study, a most practical value for γ was found to be (10^{11} L^{-2}) . The numerical solutions are derived in terms of isotherms, streamlines. The heated surface's average Nusselt number (upper wall) is used to calculate the heat transfer coefficient.

$$N_{ua_{av}} = \int_0^1 \left(\frac{\partial \theta}{\partial y} \right)_{y=0} dx. \text{ Also, the bulk temperature is calculated from the relation } \theta_{av} = \int_0^1 \frac{\theta dv}{v}$$

Comparison and Validation of the Study:

The geometry under study in this paper is a mixed ventilated cavity, so a number of grid size sensitivity tests, along with the continuity equation $\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \right) = 0$, were conducted. The results showed that the distribution of velocity for the grid size determined by enforcing a precision of 10^{-3} was validated precisely. This precision represents a compromise between run-by-run time and result

accuracy. Fig. (2-a)depicts the grid domain for $Ri = 1$, $Re = 20$ and Figure (2-b)shows the distribution of $\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right) = 0$ over the domain. The grid independency test is presented in table-1 . this table shows that the Nu_{av} becomes stable beyond grid 5 therefore, the grid 6 (nodes=4445) is adopted in this paper.

Abood et al. [15] and Rahman et al. [16] validate a computational model for mixed convection heat transfer through examining the correlation of mixed convection with uniform circulation of heat in the left side . Fig. (3) illustrates how the current investigation's flow and thermal fields compare, and Abood et al [15] and Rahman et al [16]. The findings indicate a good agreement.

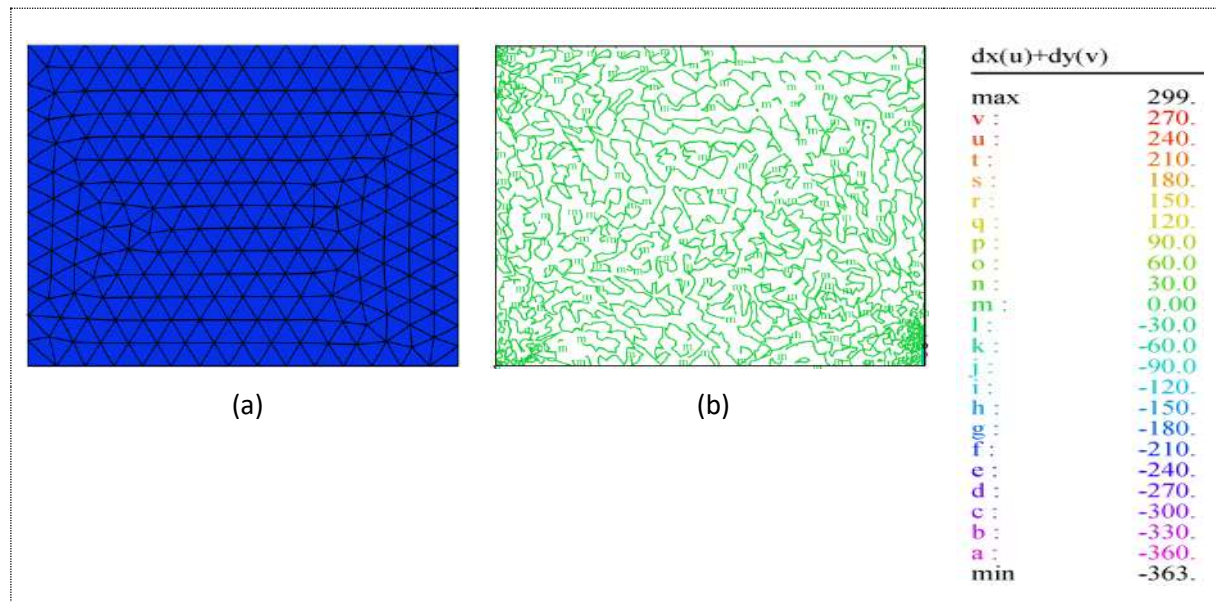


Figure 2. (a) domain-wide grid distribution (b) Verification of continuity equation

Table 1. Independency grid test

Grids	Nodes	Nu_{av} .		
		Air	Water	Oil
1	930	2.9212	3.3298	7.6952
2	2074	3.7942	3.7595	8.9601
3	2699	4.3006	4.1887	10.3718
4	3421	4.7522	4.6251	11.0615
5	4152	5.6539	5.69	11.948
6	4445	5.654	5.70	11.95

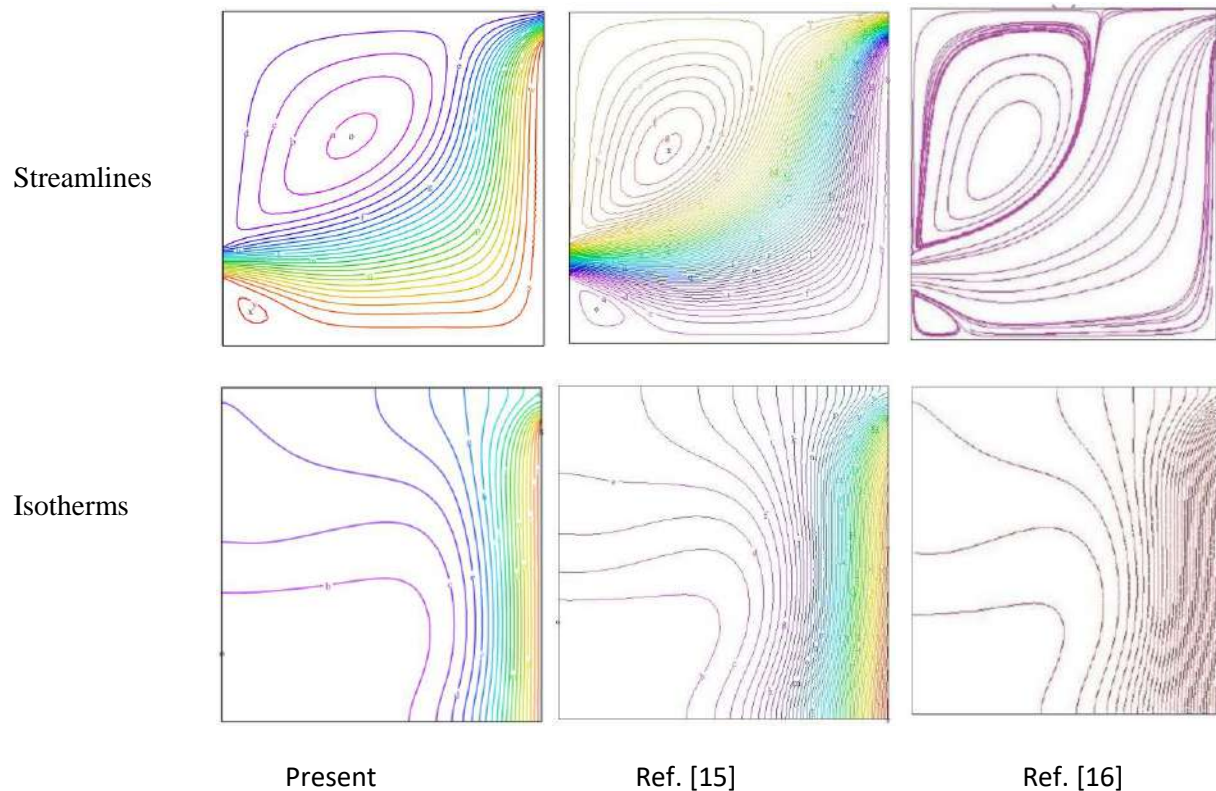


Figure 3. Validation through comparison of streamlines and isotherms at $Pra=0.71$, $Ric=1$ and $Re=100$ with Ref. [15] and Ref. [16]

Results and Discussion:

1. Effect of Re

Numerical simulations are run for various Pra (varying from 0.71, 1.7 and 50) to cover various working fluids (water, air, and oil) under the influence of Re , and Ric , varying from (20, 80, and 100) for Re , (1,6,10) for Ric , respectively. In the case of mixed convection, Pra affects the temperature distribution and the rate of heat transfer regime are mainly investigated. For a better layout, notice that the streamlines' and isotherms' contours are arranged horizontally.

The velocity direction always aligns with the y direction and is the opposite of the gravity direction. The streamlines, isotherms lines and Nu_{av} as representations of the numerical results. The studied parameters have the following ranges: $Ric = (1,6,10)$, $Pra = (0.71,1.7,50)$, $Re = 20-80$, and 100, respectively. For air, $Pra = 1.7$, $Ric = 1$ and $Re = (20,50, 80)$. Figure 4(a, b, and c) illustrate the effect of variations in Reynolds number on streamlines (left) and isotherms (right). As evidenced by this figure that The formation of two circulating cells, one located the bottom and the other in the left upper corner. The streamlines increased with increasing Re number due to the flow circulation's impact. Additionally, this figure demonstrates a growth in the expansion of the thermal boundary layer along the top wall of the space.

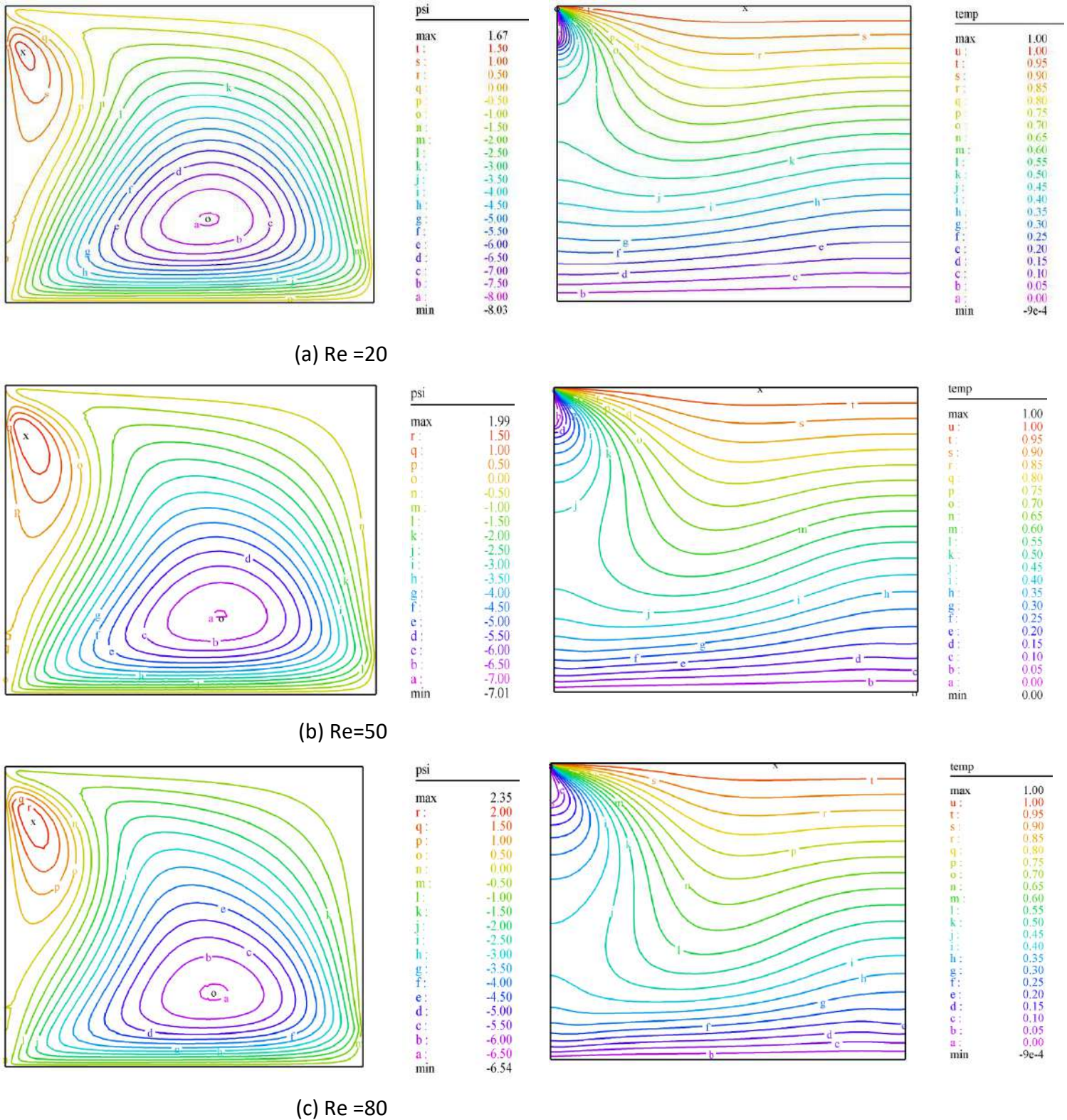


Figure 4. Streamlines (left) and isotherms (right) at Ric =1 and Pra =0.71, (a) Re =20, (b)Re=50 and (c) Re=80.

For water, Pra = 1.7, Re = 20,50, 80 and Ric =1, Figure 5(a, b, and c) illustrate the effect of variations in Reynolds number on streamlines (left) and isotherms (right). The streamlines increased with increasing Re number due to the flow circulation's impact, it can be seen the thickness of vortex

lines near the bottom moved wall. Furthermore, this image shows an increase in the temperature boundary layer's expansion across the space's upper heated wall.

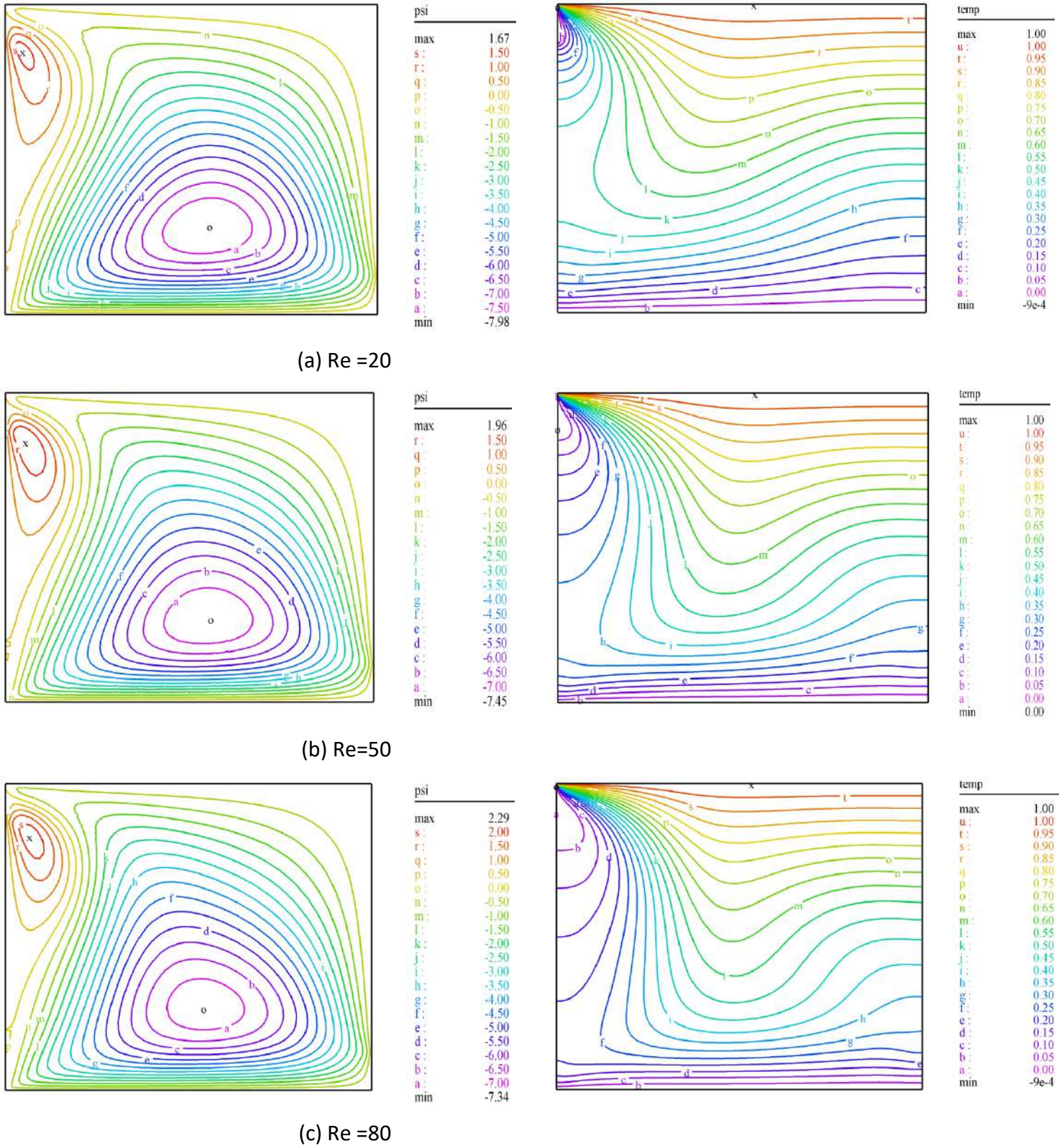


Figure 5. Streamlines (left) and isotherms (right) at Ric=1 and Pra =1.7, (a) Re =20, (b)Re=50 and (c) Re=80

For oil, $Pra = 50$, $Re = 20, 50, 80$ and $Ric = 1$, Figure 6(a, b, and c) illustrate the effect of variations in Reynolds number on streamlines (left) and isotherms (right). In streamlines contours, the secondary vortex developed near the left top corner will be grown. The streamlines increased with increasing Re number due to the flow circulation's impact. The same graph also shows an increase in the thermal boundary layer's extension along the space's upper wall. This illustrates how buoyancy increases when Re is low, resulting in a drop in air density and a flow toward the exit.

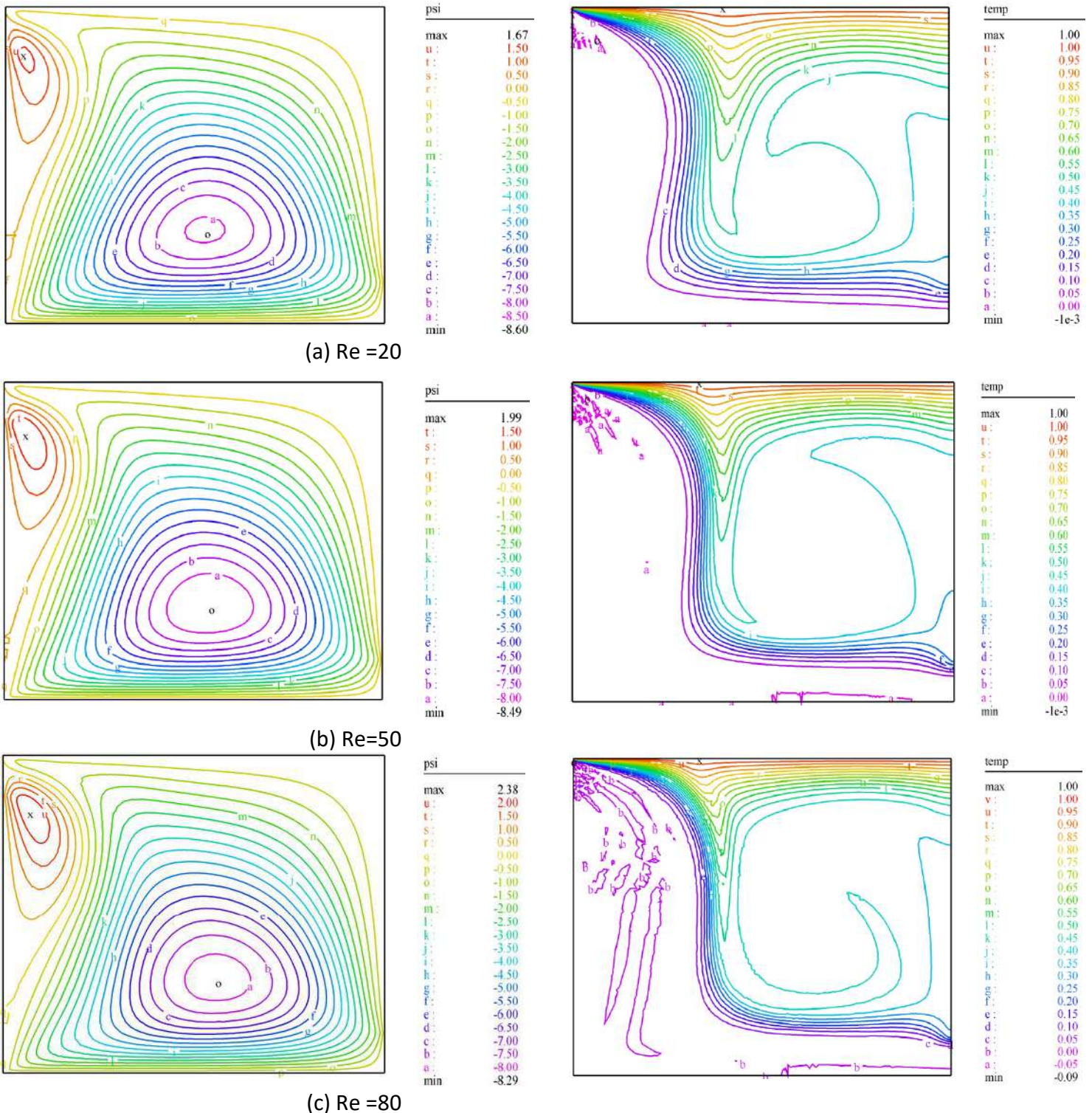


Figure 6. Streamlines (left) and isotherms (right) at $Ric = 1$ and $Pra = 50$, (a) $Re = 20$, (b) $Re = 50$ and (c) $Re = 80$.

2. Effect of Ri

Richardson's number Ri is in order to accurately predict the weather and investigate density and turbidity currents in lakes, oceans, and reservoirs, Ri is crucial. It represents the proportion of the buoyancy term to the flow shear term as a dimensionless number. Figure 7. (a, b, and c) show the effect of different values of Ri number variation on Nu_{av} for $Re=20$, and $Pra=50$. It is evident that the Nu_{av} increases progressively as the Ri number increases. Due to the buoyancy effect, this increases roughly linearly.

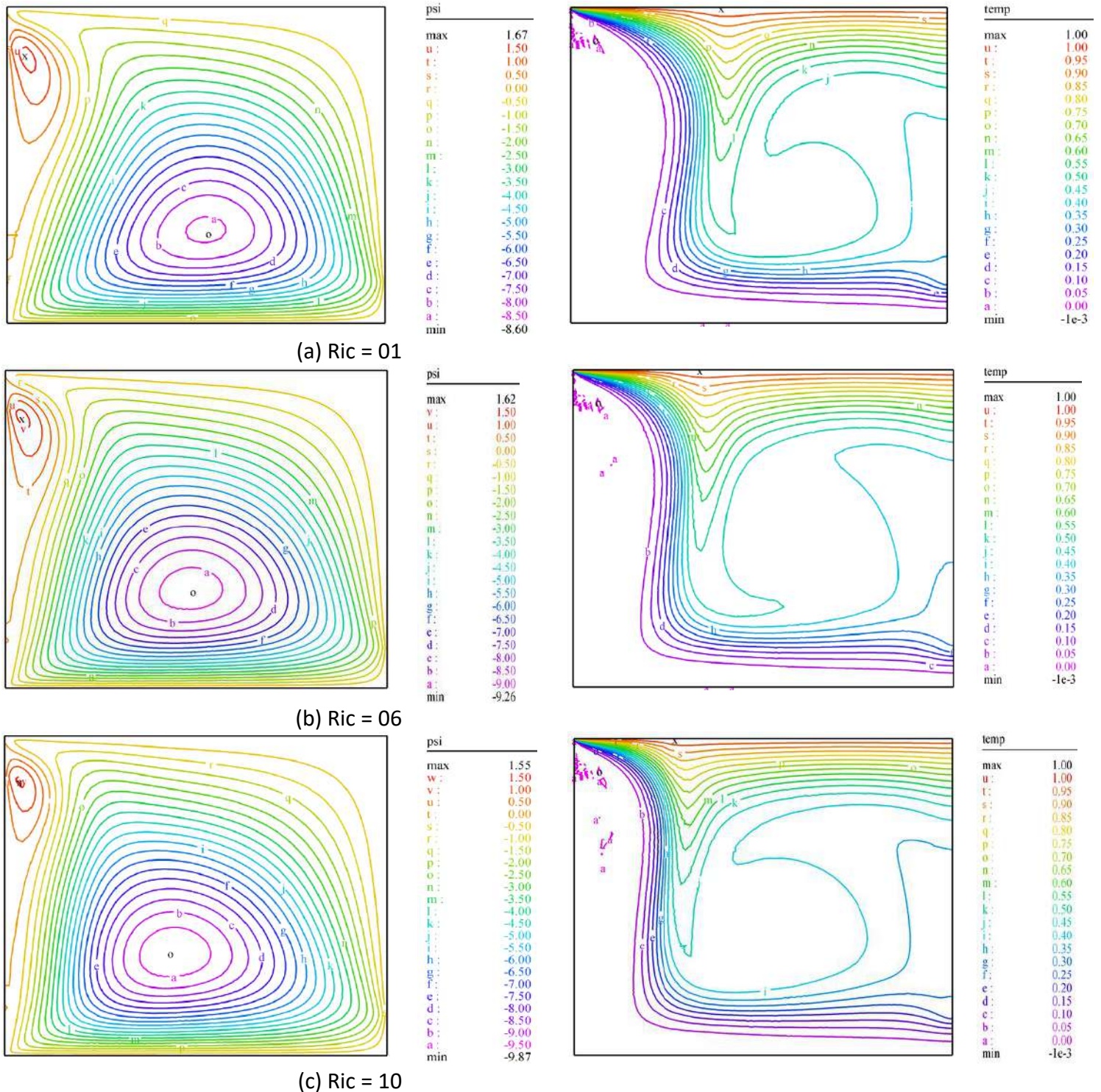


Figure 7. Streamlines (left) and isotherms (right) at $Re = 20$ and $Pra = 50$, (a) $Ri = 1$, (b) $Ri = 6$ and (c) $Ri = 10$.

Figure 8. (a, b, and c) show the effect of different values of Ric number variation on Nu_{av} for $Re=20$, and $Pra=1.7$. It is evident that when the Ric number increases, the Nu_{av} increases progressively. This increases almost linearly as a result of the buoyancy impact.

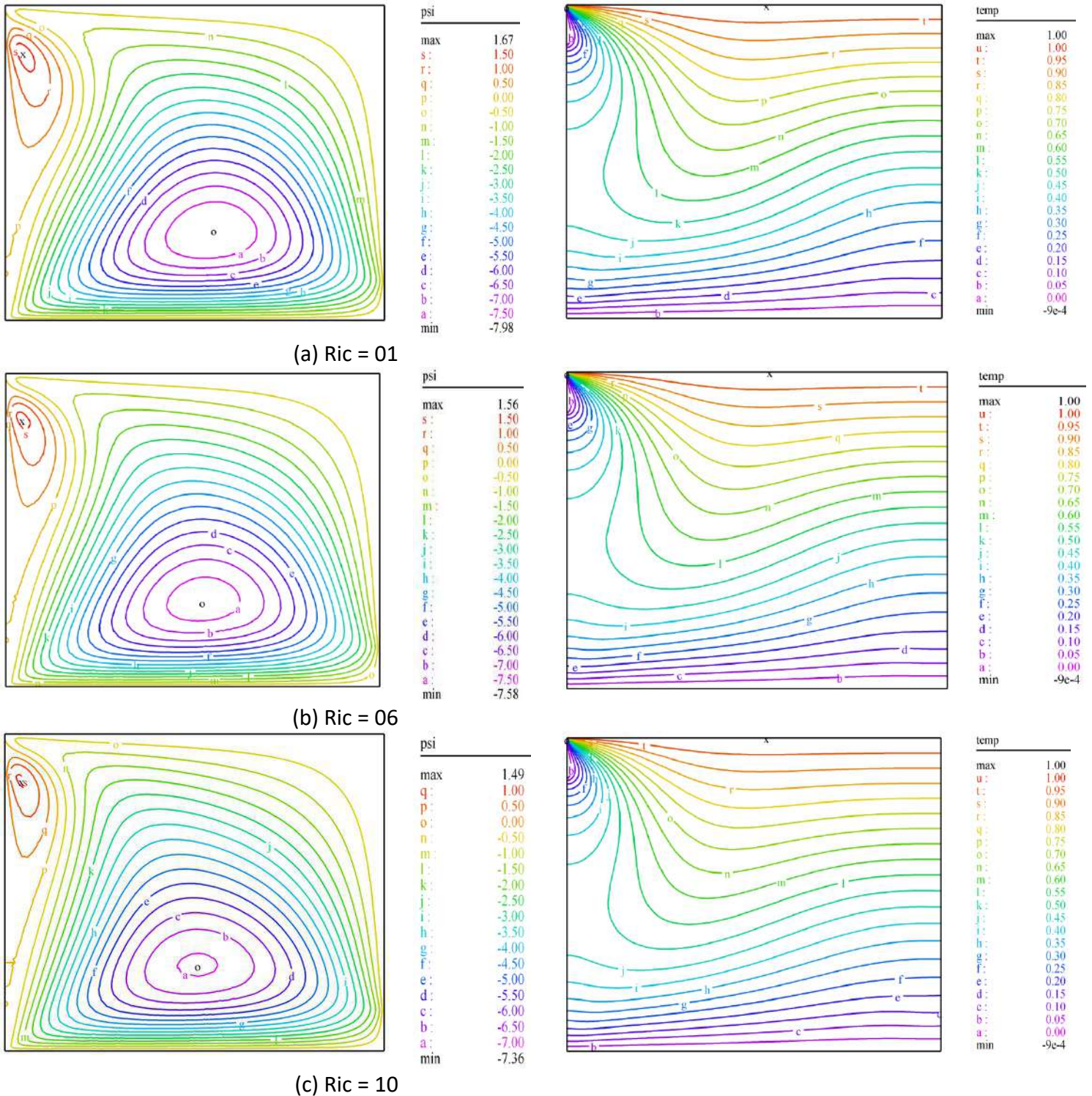


Figure 8. Streamlines (left) and isotherms (right) at $Re = 20$ and $Pra = 1.7$, (a) Ric=1, (b) Ric=6 and (c) Ric=10.

Figure 9. (a, b, and c) show the effect of different values of Ri number variation on Nu_{av} for $Re=20$, and $Pra=0.71$. As can be seen, the Nu_{av} gradually increases as the number of Rics increases. This increases roughly linearly as a result of the buoyancy effect.

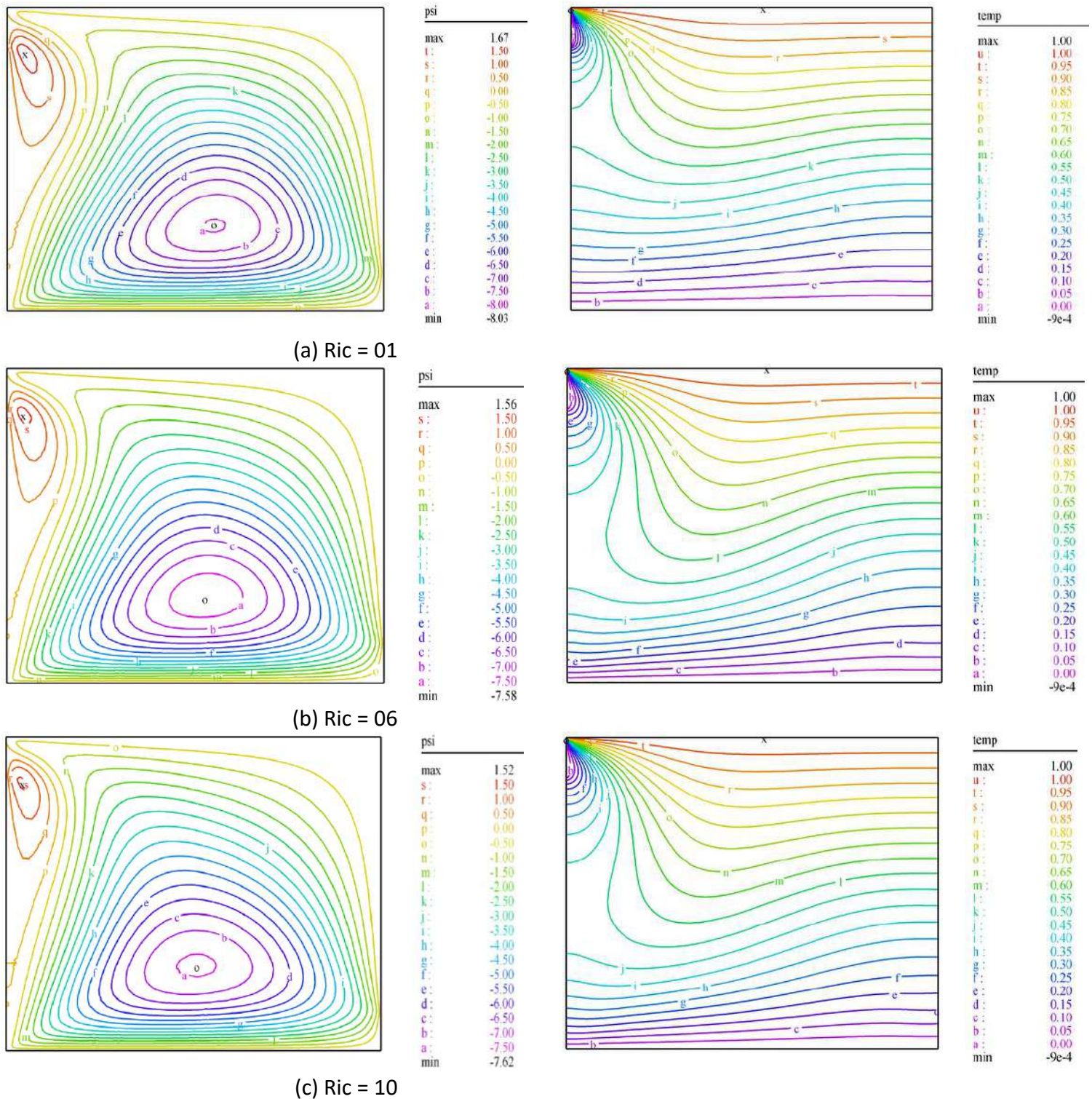


Figure 9. Streamlines (left) and isotherms (right) at $Re = 20$ and $Pra = 0.7$, (a) $Ric = 1$, (b) $Ric = 6$ and (c) $Ric = 10$.

3. Nusselt number and average temperature

Figure 10 illustrates how the average Nusselt value is affected by the Re number. It is evident that when Re and Prandtl numbers rise, Nu_{av} 's value also rises. The impact of Ri number on the Nu_{av} , which falls with increasing Ri number, is depicted in Fig. 11. Table 2 shows how θ_{av} varies with Re at $Ri=1$ and for water, oil, and air. It has been seen that as Re increases, the average temperature falls. Table 3 shows how θ_{av} varies with Ri for air, water, and oil at $Re=20$. Because forced convection predominates, it has been noticed that the average temperature lowers as Re increases.

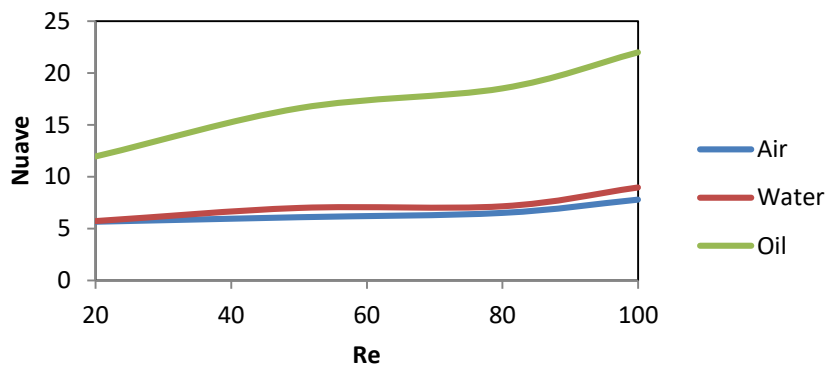


Figure 10. effect of Re number on the average of Nu_{av} for different fluids

Table 2. Variation of average fluid temperature with Reynolds number at $Ri=1$ for different Prandtl number

Air Pra 0.71				
Re	20	50	80	100
θ_{av}	0.4217	0.4200	0.4179	0.401
Water Pra 1.7				
Re	20	50	80	100
θ_{av}	0.4154	0.3948	0.371	0.358
Oil Pra 50				
Re	20	50	80	100
θ_{av}	0.2679	0.2283	0.2057	0.192

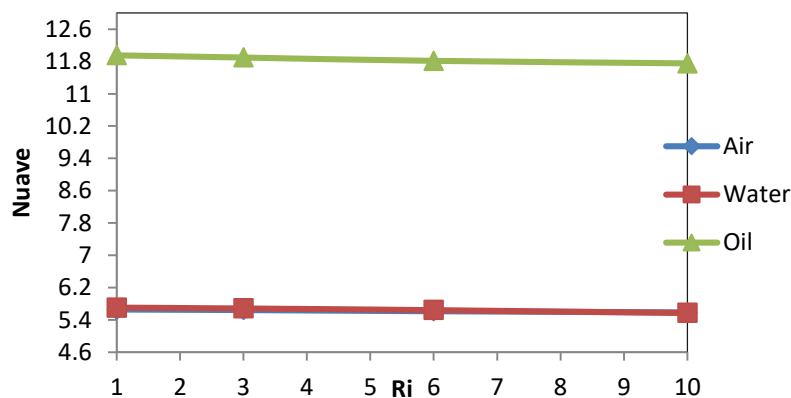


Figure 11. effect of Ri number on the average of Nu_{av} for different fluids

Table 3. Variation of average fluid temperature with Richardson number at $Re=20$ for different Prandtl number

Air Pra 0.71				
Ri	1	3	6	10
θ_{av}	0.4217	0.40128	0.40076	0.382
Water Pra 1.7				
Ri	1	3	6	10
θ_{av}	0.4154	0.4142	0.403	0.392
Oil Pra 50				
Ri	1	3	6	10
θ_{av}	0.2679	0.266	0.253	0.19

Conclusions

Flex PDF software has been used in this study to investigate the effects of variable Prandtl number on mixed convection of a laminar flow and heat transfer in a rectangular enclosure. By varying the Reynolds Number (20 Re 100) and the Richardson Number (1 Ric 10) fluid flows, the numerical results are examined. The following findings have been summarized:

- A) The average Nusselt number is maximum at the heated surface with the highest Reynolds value. b. Nusselt numbers decline as Ric rises.
- B) the value of average temperature θ_{av} decreasing with increasing Re and Ric .
- C) For oil, the average Nusselt number is higher than water, and water is higher than air (due to the difference in density).
- D) The average temperature θ_{av} for oil is less than that for water and air for the same value of Re .

Nomenclature

- g Gravitational acceleration, meter/sec²
- W The square enclosure's height, meter
- k Conductivity of thermal, Watt/meter².K
- L The heated wall's length, meter
- N Dimensionless normal distance
- Nus Nusselt Number
- Nus_{av} Average Nusselt Number
- P** A pressure without dimensions, pascal / ρu_{in}^2
- Pra Prandtl Number, ν/α
- Ric Richardson Number, Gr/Re^2
- Re Reynolds Number, $u_{in} L/\nu$
- Te Fluid in the enclosure's temperature, K
- UU,VV Components of non-dimensional velocity, uu/u_{in} , vv/u_{in}
- w Inlet opening height, (1/10) L
- W The inlet's non-dimensional height, w/L
- XX, YY coordinates that are not dimensional, $XX=xx/L$, $YY=yy/L$

Greek Symbols

- α Fluid thermal diffusivity, meter²/sec
- β coefficient of thermal expansion, 1/K
- θ Temperature dimensionless, $\theta=(T_e-T_{e_{in}})/(T_h-T_{e_{in}})$
- ν Kinematics viscosity, meter²/s
- ρ Density , kg/meter³

Subscripts

- h Hot
- in Inlet

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الذكاء الاصطناعي وأثره في تخفيض تكاليف العمليات الجراحية دراسة نظرية

Artificial Intelligence and Its Impact on Reducing the Costs of Surgeries: Theoretical Study

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Abstract

Artificial intelligence has made great progress in many medical aspects such as diagnosis, medicine, and biotechnology, and it has also had an impact on surgical operations and reduced their cost. Accordingly, the study aimed to determine the impact of artificial intelligence in reducing the costs of surgeries. The study followed the descriptive approach by reviewing previous literature, studies, and research related to the topic. The results indicate that there is increasing competition in the surgical robotics market after years of monopolizing the da Vinci system. This competition encourages development and innovation in this field, which can lead to more advanced and cost-effective options. In addition, the new surgical robots come with technological improvements aimed at reducing the cost of surgery and increasing efficiency. Open consoles, lighter tools, and greater portability are part of these improvements. The results indicate that the new devices can reduce the cost of robotic surgery to be comparable to that of laparoscopy. Despite the large upfront costs of the hardware, an approach to offering comprehensive cost models could make bots attractive for expanded use. The study recommended that embedding applied examples from actual studies or clinical trials to illustrate the benefits and challenges would be useful to the reader, invest more efforts in research and innovation in the field of artificial intelligence, training and mentoring of surgeons, conducting continuous evaluations of the effectiveness achieved by artificial intelligence, providing infrastructure support, and finally, Providing comprehensive cost models that include long-term benefits to achieve greater investment attraction in this field.

Key Words Artificial Intelligence ; Surgeries, Surgery ; Robotics ; Costing ; Machine Learning ; Deep Learning ; Natural Language Processing.

ملخص

حقق الذكاء الاصطناعي تقدماً كبيراً في العديد من الجوانب الطبية مثل التشخيص والأدوية والتكنولوجيا الحيوية، كما كان لها أثر على العمليات الجراحية وتقليل تكلفتها، بناءً على ذلك هدفت الدراسة إلى تحديد أثر الذكاء الاصطناعي في تخفيض تكاليف العمليات الجراحية. اتبعت الدراسة المنهج الوصفي وذلك من خلال مراجعة الأدبيات والدراسات والأبحاث السابقة ذات الصلة بالموضوع. تشير النتائج إلى وجود منافسة متزايدة في سوق الروبوتات الجراحية بعد سنوات من احتكار نظام دافنشي. هذا التنافس يشجع على التطوير والابتكار في هذا المجال، مما يمكن أن يؤدي إلى تقديم خيارات أكثر تقدماً وفعالية من حيث التكلفة. إضافة إلى ذلك الروبوتات الجراحية الجديدة تأتي مع تحسينات تكنولوجية تهدف إلى تقليل تكلفة الجراحة وزيادة الكفاءة. وحدات التحكم المفتوحة والأدوات الأخف وزناً وإمكانية النقل الأكبر تمثل جزءاً من هذه التحسينات. تشير النتائج إلى قدرة الأجهزة الجديدة على تقليل تكلفة الجراحة الروبوتية لتكون مماثلة لتكلفة تنظير البطن. على الرغم من التكاليف الأولية الكبيرة للأجهزة، إلا أن توجه نحو تقديم نماذج تكلفة شاملة يمكن أن يجعل الروبوتات جذابة للتوسع في الاستخدام. أوصت الدراسة بتضمين أمثلة تطبيقية من الدراسات الفعلية أو التجارب السريرية لتوضيح الفوائد والتحديات سيكون مفيداً للقارئ، واستثمار مزيد من الجهود في البحث والابتكار في مجال الذكاء الاصطناعي، والتدريب والتوجيه للجراحين، إجراء تقييمات مستمرة للفعالية التي يحققها الذكاء الاصطناعي، تقديم الدعم للبنية التحتية، وأخيراً، تقديم نماذج تكلفة شاملة تشمل فوائد طويلة الأمد لتحقيق جذب أكبر للاستثمار في هذا المجال.

الكلمات المفتاحية: الذكاء الاصطناعي؛ العمليات الجراحية؛ الجراحة؛ الروبوت؛ تكلفة؛ التعلم الآلي؛ التعلم العميق؛ معالجة اللغات الطبيعية

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لقد اخترق الذكاء الاصطناعي (AI) وعلوم الروبوتات أنواعًا مختلفة من الأعمال والصناعات في السنوات الأخيرة. يمكن تعريف الذكاء الاصطناعي على أنه الدراسة المستقبلية والنظرية للعمليات الإدراكية والفكرية باستخدام أجهزة الكمبيوتر لجعل الكمبيوتر يدرك ويفهم ويتصرف بطرق ممكنة الآن فقط للبشر (Achacoso, 1990). تم إدخال الروبوتات، باعتبارها أحد أنواع الذكاء الاصطناعي الشبيه بالإنسان، لأول مرة في صناعة التحويل والتعامل مع المنتجات من أجل استبدال العمل البشري منذ عقود مضت (Murauskiene, 2015). في الوقت الحالي، تمتد تطبيقات الذكاء الاصطناعي وعلوم الروبوتات إلى صناعات أخرى، على سبيل المثال، في وسائل النقل كمركبات ذاتية القيادة (Maurer et al., 2016)، وفي الصناعة الطبية للتشخيص والعمليات الجراحية (Kaur, 2012; Mirheydar & Parsons, 2013)، في صناعة التعليم لتعليم أو مساعدة الأطفال ذوي الاحتياجات الخاصة (Timms, 2016)، في إدارة سلسلة التوريد لتنظيم المستودعات (Min, 2010)، وما إلى ذلك.

الذكاء الاصطناعي هو الذكاء الذي تظهره الآلات الذي يعتمد على التعلم المعزز ويدور حول استخدام الخوارزميات. لقد وجد الذكاء الاصطناعي بالفعل مكانًا لا يمكن الاستغناء عنه في حياتنا من خلال استخدامه بواسطة الهواتف الذكية والمساعدات الشخصية مثل Alexa والعديد من التطبيقات الأخرى. يستمد الذكاء الاصطناعي الإلهام من الشبكة العصبية المعقدة للدماغ ويستخدم "الخلايا العصبية" الاصطناعية التي تتعلم من خلال مقارنة نفسها بالمرجعات المرغوبة و"تعزيز" الاتصالات المفيدة، وبالتالي إنشاء الأساس لنهج الشبكة العصبية الاصطناعية. ينشئ مجال الرعاية الصحية قواعد بيانات طبية ضخمة، تُعرف أيضًا باسم "البيانات المضخمة" والتي تشمل سجلات الرعاية المختصة بالصحة والتصوير وعلم الأمراض ومقاطع الفيديو الجراحية. يمكن أن يساعد تحليل البيانات المضخمة بمساعدة الذكاء الاصطناعي في تشخيص الأمراض مبكرًا وكذلك التنبؤ بالنتائج بشكل أفضل، مما سيؤدي في النهاية إلى رعاية صحة للمجتمع فعالة واقتصادية (Bonrath et al., 2015).

يتضمن إشراك الذكاء الاصطناعي في الإدارة المحيطة بالجراحة التقييم قبل الجراحة مع تنبؤات دقيقة بالمخاطر، وتشمل الإدارة أثناء العملية الروبوتات التنبؤ والتشغيل، وأجهزة التسريب، ومراقبة عمق التخدير (DOA)، والكشف المبكر عن التخدير والمضاعفات الجراحية. قد يتم تقليل النطاق الواسع للذكاء الاصطناعي وقدرة الشبكات العصبية العميقة (DNN) على تحليل مقاطع الفيديو أثناء العملية، ومنحنى التعلم، والحوادث الوشيكة في الجراحة طفيفة التوغل (Bonrath et al., 2015). بعد العملية الجراحية، أظهر الذكاء الاصطناعي دورًا في الحد من التهابات الموقع الجراحي (SSI)، والتهابات SSI داخل البطن بعد العمليات الجراحية المعوية (da Silva et al., 2019; Chapman et al., 2017)، وتحديد التسربات المفاغرة من السجلات الصحية الإلكترونية (Soguero-Ruiz et al., 2014; Brennan et al., 2019). من المتوقع أن تؤدي تطبيقات الذكاء الاصطناعي في المستقبل القريب إلى تغيير الممارسة بشكل كبير، وبالتالي يصبح من الضروري أن يتم تحديث الجراحين وأطباء التخدير بالتطبيقات الحالية والاستخدامات المستقبلية المحتملة.

مشكلة البحث وتساؤلاته

تشهد الدول المتقدمة سابقًا "سريعًا وملفتًا قويًا" في مجال تكنولوجيا الروبوت، حيث بدأت الأجهزة الآلية توغل تدريجيًا في أغلب جوانب الحياة اليومية، كمثال في مجالات التصنيع، والصحة المجتمعية، والأمن والدفاع، والاستكشاف الفضائي، وميادين الخدمات والأعمال المنزلية، وغيرها العديد من المجالات. ووفقًا لتوقعات خبراء الروبوتات والذكاء الاصطناعي، يمكن أن تصبح الأجهزة الآلية جزءًا لا غنى عنه في حياة المجتمع البشري خلال الفترة القريبة المقبلة. وأصبحت تكنولوجيا الأتمتة اليوم صناعة عالمية ومجالًا واعدًا، حيث أصبح مستوى تقدم هذه التكنولوجيا مؤشرًا لقوة البنية الصناعية للدول (الحضري، 2018).

كما حقق الذكاء الاصطناعي تقدماً كبيراً في العديد من الجوانب الطبية مثل التشخيص والأدوية والتكنولوجيا الحيوية، كما كان لها أثر على العمليات الجراحية وتقليل تكلفتها، وبناء على مشكلة الدراسة تريد الدراسة الإجابة على الأسئلة الآتية:

1. ما هي فروع الذكاء الاصطناعي في مجال الطب؟
2. كيف يستخدم الذكاء الاصطناعي في الجراحة؟
3. كيف يؤثر الذكاء الاصطناعي في تخفيض وتقليل تكاليف العمليات الجراحية؟

أهمية البحث

والتي يمكن تلخيصها بالنقاط التالية:

- تنطلق أهمية الدراسة من أهمية الذكاء الاصطناعي في القرن الحالي، خاصة بعد دخوله في ميادين مختلفة منها الميدان الطبي، لذلك تطرقنا في هذه الدراسة تأثير الذكاء الاصطناعي على التداخلات الجراحية والعمليات من حيث تقليل التكلفة.
- كما يكمن أهمية البحث بحد ذاته، حيث تنطلق حدائته من حداثة التكنولوجيا بمختلف أنواعها الحديثة واستغلالها في ميدان الطب والجراحة، حيث أن أغلب الباحثين لم يولوا بعد الاهتمام الكافي بهذا النوع من المواضيع ولم يعطوها حقها رغم دخول الذكاء الاصطناعي في مجال الجراحة، وهذا ما يفسر قلة الدراسات التي تناولت هذا الموضوع في بلداننا على الخصوص.

أهداف البحث

يهدف البحث إلى تحقيق النقاط التالية:

1. مناقشة فروع الذكاء الاصطناعي في الطب.
2. مناقشة استخدام الذكاء الاصطناعي في الجراحة.
3. مناقشة تأثير الذكاء الاصطناعي في تقليل تكاليف العمليات الجراحية.

مصطلحات البحث

- الذكاء الاصطناعي: هو فرع من تخصصات علوم الحاسوب، ويمثل العلم الذي يهدف إلى منح الآلات القدرة على التفكير بطريقة تشابه الإنسان، أي أجهزة الحاسوب التي تتمتع بقدرة عقلية. كما يُعرّف أيضاً باعتباره سلوكاً وخصائص مميزة تُضيفها على البرامج الحاسوبية، مما يمكنها من محاكاة القدرات العقلية البشرية وأنماط عملها. من الخصائص الرئيسية لهذا المجال قدرة الأنظمة على التعلم واستنتاج المعلومات والتفاعل مع السياقات غير المبرمجة مسبقاً. وبشكل عام، يُشير هذا المصطلح إلى الأنظمة والأجهزة التي تحاكي الذكاء البشري لأداء مهام متنوعة، والقدرة على تحسين أدائها بناءً على المعلومات التي تقوم بجمعها. (محمد، 2021)
- العمليات الجراحية: الجراحة هو مصطلح يُستعمل عموماً للإشارة إلى الخطوات المُعروفة بالعمليات الجراحية، التي تنطوي على تدخّل يدوي أو تطبيق تقنيات خاصة على الأنسجة بهدف معالجة الأمراض أو الإصابات أو التشوهات. غير أنّ التقدم التكنولوجي وتطور الأساليب الجراحية قد جعل من تعريف هذا المصطلح أمراً أكثر تعقيداً. فبعض الأحيان، يمكن استخدام تقنيات كالليزر أو الإشعاع أو وسائل أخرى لقطع الأنسجة، وحتى إغلاق الجروح يمكن تحقيقه بدون الحاجة للخياطة التقليدية.

الدراسات السابقة

فيما يلي استعراض لأبرز الدراسات السابقة ذات العلاقة في البحث الحالي :

دراسة (Rasouli et al., 2021) بعنوان " الذكاء الاصطناعي والروبوتات في جراحة العمود الفقري"، حيث كان الغرض من الدراسة تجميع وتحليل ومناقشة الاتجاهات والتطبيقات الحالية للذكاء الاصطناعي والتعلم الآلي في جراحة العمود الفقري التقليدية والمدعومة بالروبوتات. كانت منهجية الدراسة وصفية و مراجع المؤلفات السابقة والأبحاث ذات الصلة. لقد أجرت الدراسة بحثاً شاملاً في PubMed عن المقالات التي راجعها النظراء والتي تم نشرها بين عامي 2006 و2019 والتي تتناول الذكاء الاصطناعي وتعلم الآلة والروبوتات في جراحة العمود الفقري. ركزت غالبية مؤلفات الذكاء الاصطناعي المنشورة في جراحة العمود الفقري على التحليلات التنبؤية والتعرف على الصور الخاضعة للإشراف للتشخيص الشعاعي. لقد درس العديد من الباحثين استخدام الذكاء الاصطناعي/التعلم الآلي في البيئة المحيطة بالجراحة في مجموعات صغيرة من المرضى.

دراسة (Solanki et al., 2021) بعنوان "الذكاء الاصطناعي في الإدارة المحيطة بالجراحة لجراحات الجهاز الهضمي الكبرى"، والتي هدفت إلى تلخيص المفاهيم والنطاق والتطبيقات والقيود في جراحة الجهاز الهضمي الكبرى. هذه مراجعة سردية للأدبيات المتوفرة حول القدرات الرئيسية للذكاء الاصطناعي لمساعدة أطباء التخدير والجراحين وغيرهم من الأطباء على فهم تطبيقات الذكاء الاصطناعي الحالية والجديدة وتقييمها بشكل نقدي في الإدارة المحيطة بالجراحة. يؤدي التنفيذ الدقيق واستخدام الذكاء الاصطناعي إلى جانب التفسير البشري في الوقت الفعلي إلى إحداث ثورة في الرعاية المحيطة بالجراحة، وهو الطريق إلى الأمام في الإدارة المستقبلية للجراحة الكبرى في الفترة المحيطة بالجراحة.

دراسة (Bohr and Memarzadeh, 2020) بعنوان " ظهور الذكاء الاصطناعي في تطبيقات الرعاية الصحية"، التي سعت إلى مناقشة بعض التطبيقات الرئيسية للذكاء الاصطناعي في مجال الرعاية الصحية والتي تغطي كلاً من التطبيقات المرتبطة مباشرة بالرعاية الصحية وتلك الموجودة في سلسلة قيمة الرعاية الصحية مثل تطوير الأدوية والمعيشة المحيطة. كانت منهجية الدراسة وصفية من خلال مراجع المؤلفات السابقة والأبحاث ذات الصلة. أوجدت الدراسة أن هناك تفاعل كبير بأن تطبيق الذكاء الاصطناعي (AI) يمكن أن يوفر تحسينات كبيرة في جميع مجالات الصحة المجتمعية من التشخيص إلى العلاج. من المعتقد بشكل عام أن أدوات الذكاء الاصطناعي ستسهل وتعزز العمل البشري ولن تحل محل عمل الأطباء وغيرهم من موظفي الرعاية الصحية في حد ذاتها. الذكاء الاصطناعي جاهز لدعم موظفي الرعاية الصحية بمجموعة متنوعة من المهام بدءاً من سير العمل الإداري وحتى التوثيق السريري والتواصل مع المرضى بالإضافة إلى الدعم المتخصص مثل تحليل الصور وأتمتة الأجهزة الطبية ومراقبة المرضى.

دراسة (Ahuja, 2019) بعنوان " تأثير الذكاء الاصطناعي في الطب على الدور المستقبلي للطبيب"، والتي هدفت إلى فهم هذه التكنولوجيا بشكل أفضل وكيفية تغيير الطب. ولتحقيق هذه الغاية، تبحث هذه الورقة في دور الأنظمة القائمة على الذكاء الاصطناعي في أداء العمل الطبي في التخصصات بما في ذلك الأشعة، وعلم الأمراض، وطب العيون، وأمراض القلب. ويخلص إلى أن الأنظمة القائمة على الذكاء الاصطناعي ستعمل على تعزيز الأطباء ومن غير المرجح أن تحل محل العلاقة التقليدية بين الطبيب والمريض. كانت منهجية الدراسة وصفية من مراجع المؤلفات السابقة والأبحاث ذات الصلة. وجدت الدراسة أن ممارسة الطب تتغير مع تطور أساليب الذكاء الاصطناعي الجديدة للتعلم الآلي. إلى جانب التحسينات السريعة في معالجة الكمبيوتر، تعمل هذه الأنظمة القائمة على الذكاء الاصطناعي بالفعل على تحسين دقة وكفاءة التشخيص والعلاج عبر مختلف التخصصات. أدى التركيز المتزايد للذكاء الاصطناعي في مجال الأشعة إلى اقتراح بعض الخبراء أن الذكاء الاصطناعي قد يحل محل أطباء الأشعة في يوم من الأيام.

دراسة (Hashimoto et al., 2018) بعنوان "الذكاء الاصطناعي في الجراحة: الوعود والمخاطر"، والتي هدفت لتلخيص الموضوعات الرئيسية في الذكاء الاصطناعي (AI)، بما في ذلك تطبيقاتها وقيودها في الجراحة. تستعرض هذه الدراسة القدرات الرئيسية

للذكاء الاصطناعي لمساعدة الجراحين على فهم تطبيقات الذكاء الاصطناعي الجديدة وتقييمها بشكل نقدي والمساهمة في التطورات الجديدة. تم إجراء مراجعة لأوراق الذكاء الاصطناعي عبر علوم الكمبيوتر والإحصاءات والمصادر الطبية لتحديد المفاهيم والتقنيات الأساسية داخل الذكاء الاصطناعي التي تقود الابتكار عبر الصناعات، بما في ذلك الجراحة. كما تمت مراجعة القيود والتحديات التي تواجه العمل مع الذكاء الاصطناعي. تم تحديد أربعة مجالات فرعية رئيسية للذكاء الاصطناعي: (1) التعلم الآلي، (2) الشبكات العصبية الاصطناعية، (3) معالجة اللغة الطبيعية، و(4) رؤية الكمبيوتر. وتم تقديم تطبيقاتهم الآنية واللاحقة في الممارسة الجراحية، بما في ذلك تحليلات البيانات الضخمة وأنظمة دعم القرار السريري. تمت مناقشة آثار الذكاء الاصطناعي على الجراحين ودور الجراحين في تطوير التكنولوجيا لتحسين الفعالية السريرية.

ودراسة (Gumbs et al., 2021) بعنوان "جراحة الذكاء الاصطناعي: كيف نصل إلى إجراءات مستقلة في الجراحة؟"، التي ناقشت جوانب التعلم الآلي و التعلم العميق ورؤية الكمبيوتر ومعالجة اللغات الطبيعية من حيث صلتها بالممارسة الحديثة للجراحة، مع التركيز على قضايا الذكاء الاصطناعي الحالية والمطورة لاحقا التي ستمكننا من الوصول إلى إجراءات أكثر استقلالية في الجراحة. كانت منهجية الدراسة وصفية من مراجعه المؤلفات السابقة والأبحاث ذات الصلة. وجدت الدراسة أنه يتطلب تطوير نظام جراحة الذكاء الاصطناعي تجميع كم كبير من مقاطع الفيديو التي تصور إجراءات الجراحة. يتطلب ذلك مئات إن لم يكن الآلاف من مقاطع الفيديو المشروحة بالكامل لكل نوع محدد من العمليات الجراحية والتي يمكن استخدامها ومشاركتها داخل مجتمع البحث. ولتلبية هذا المطلب، يجب أن يكون تجميع البيانات وإعدادها وشرحها جزءًا من العلاجات الطبية المستقبلية. كما يتطلب أيضًا تعاونًا وثيقًا ومتعدد التخصصات من مجتمع الذكاء الاصطناعي والمجتمعات الطبية. ستتضمن الإجراءات المستقلة في الجراحة الروبوتية تفاعلًا معقدًا بين تعلم الآلة وتعلم التعلم والسيرة الذاتية وربما البرمجة اللغوية العصبية. يجب أن يصبح الجراحون المعاصرون على دراية بأساسيات الذكاء الاصطناعي لدمج هذا المجال الجديد المثير بشكل أفضل في الممارسة الجراحية. يجب على الجراحين الأكاديميين الشباب التفكير في اكتساب الخبرة في هذا المجال في شكل برامج الماجستير أو الدكتوراه، بدلاً من مجالات الدراسة التقليدية مثل البيولوجيا الجزيئية وعلم الوراثة وعلم المناعة.

ودراسة (Makhni et al., 2021) بعنوان "الذكاء الاصطناعي لجراح العظام: نظرة عامة على الفوائد المحتملة والقيود والتطبيقات السريرية"، التي قدّمت نظرة عامة على المفاهيم الأساسية للذكاء الاصطناعي والتعلم الآلي مع وضع جراح العظام في الاعتبار. تسلط المراجعة الضوء أيضًا على الفوائد والقيود المحتملة للذكاء الاصطناعي، إلى جانب نظرة عامة على تطبيقاته في جراحة العظام. كانت منهجية الدراسة وصفية وذلك عبر مراجعه المصادر السابقة والأبحاث ذات الصلة. وجدت الدراسة أنه يتطلب تطوير نظام جراحة الذكاء الاصطناعي جمع كم كبير من مقاطع الفيديو التي تصور إجراءات الجراحة. أوجدت الدراسة أنّ الذكاء الاصطناعي لقد نجح، جنبًا إلى جنب مع التعلم الآلي التكنولوجي التابع له، في تحويل العديد من الصناعات من خلال الكفاءات المكتشفة حديثًا واتخاذ القرارات الداعمة. وقد بدأت هذه التقنيات بالمثل في العثور على تطبيق في مجال الرعاية الصحية في الولايات المتحدة، وخاصة جراحة العظام. وعلى الرغم من أن هذه الطرائق لديها القدرة على إحداث تحول مماثل في الرعاية الصحية، إلا أن هناك قيودًا يجب أيضًا الاعتراف بها وفهمها. لسوء الحظ، ليس لدى معظم الأطباء فهم لأساسيات الذكاء الاصطناعي، وبالتالي قد يواجهون تحديات في سياق تأثيره في الصحة المجتمعية الحديثة.

منهجيته البحث

لتحقيق أهداف البحث؛ تم اتباع المنهج الوصفي وذلك من خلال مراجعة الأدبيات والدراسات والأبحاث السابقة ذات الصلة بالموضوع حيث تم الاكتفاء بالمنهج الوصفي لقلّة الدراسات العملية في مجال الذكاء الاصطناعي في مجال الجراحة العامة وجراحة المسالك البولية خاصة في العراق محل البحث.

الذكاء الاصطناعي، والتعلم الآلي، والتعلم العميق، ومعالجة اللغات الطبيعية

تمت صياغة مصطلح الذكاء الاصطناعي لأول مرة من قبل جون مكارثي في مشروعه البحثي الصيفي في دارتموث في عام 1956، لكن أسس المفهوم تعود إلى آلان تورينج الشهير (Kolanska et al., 2021). الذكاء الاصطناعي هو مزيج من الحسابات الرقمية التي يتم إجراؤها بمساعدة الكمبيوتر لخلق شكل من أشكال الذكاء. يعتقد بعض المؤلفين أن الذكاء الاصطناعي يخلق عمليات محاكاة، يتم إجراؤها مرة أخرى على جهاز كمبيوتر، مع ثلاثة أهداف رئيسية: التحليل والفهم والتنبؤ (Gumbs et al., 2021). تم اقتراح تعريف آخر يصف الذكاء الاصطناعي بأنه آلات تعمل بشكل مناسب وبصيرة.

عندما يتم أخذ هذه التعريفات ككل، يصبح من العدل أن نقول إن الذكاء الاصطناعي يتضمن استخدام الكمبيوتر لتفسير موقف ما و/أو المساعدة في إنجاز مهمة، وباختصار لجعل حياتنا أسهل وأفضل. فرعان من الذكاء الاصطناعي في الطب يتم مناقشتها غالبًا هما التعلم الآلي والتعلم العميق (Loftus et al., 2020). التعلم الآلي هو مجال يحلل كيفية استخدام خوارزميات الكمبيوتر وإحصائياته للتحسين بشكل مستقل من خلال التجربة والخطأ من خلال التعرف على الأنماط. التعلم العميق، أو التعلم المنظم العميق، هو تطبيق أوسع لمفاهيم التعلم الآلي التي يتمحور أساسها حول تكوين واستخدام "التعلم" الاصطناعي أو الشبكات "العصبية" التي تعتمد على بنية العقول البيولوجية، مثل كونها متعددة الطبقات. تتعامل معالجة اللغة الطبيعية مع التعرف على أنماط البيانات التي تأتي بتنسيقات غير منظمة (Jarvis et al., 2020).

يتمتع التعلم الآلي والتعلم العميق ومعالجة اللغة الطبيعية بإمكانات هائلة لتحسين عملية اتخاذ القرار الجراحي قبل الجراحة وبعدها. ومن خلال تحليل البيانات الضخمة، تتمتع هذه الفروع من الذكاء الاصطناعي بإمكانات هائلة لتحسين عملية صنع القرار حتى على مستوى الصحة العامة العالمية، وهو ما تم الكشف عنه خلال جائحة كورونا (Agrawal et al., 2020). ولسوء الحظ، فإن الجراحين لديهم بالفعل قيود في فهمهم للتراجعات مثل المخاطر النسبية ونسب الأرجحية (Anderson et al., 2013). في الوقت الحالي، هناك العديد من القيود على الذكاء الاصطناعي، حيث أن نماذج الانحدار الحالية غير مثالية، مما يزيد من أهمية معرفة الجراحين المعاصرين وفهم بعض أساسيات الإحصائيات (Krouss et al., 2016).

الذكاء الاصطناعي في الجراحة

يمكن للذكاء الاصطناعي أن يساعد الأطباء ومراكز المستشفيات على تحديد جودة الرعاية وتكلفتها، وتحسين النتائج، وتخفيف المخاطر المالية التي تتعرض لها المؤسسات والدافعون (Ames et al., 2019; Galbusera et al., 2019). في حين كان هناك أيضًا جدل حول الذكاء الاصطناعي إذا تم تنفيذه بشكل مناسب، إلا أنه لديه القدرة على إحداث ثورة في مستوى الرعاية في جراحة العمود الفقري، وتقليل التكلفة والهدر، وتحسين الكفاءة ورعاية المرضى. بالإضافة إلى ذلك، يمكن للذكاء الاصطناعي أن يعزز الرعاية الفردية للمرضى ويقلل من عدم التجانس في كل من الممارسة السريرية والبحث (Durand et al., 2018).

من المرجح أن تكون الاستخدامات الأولى واسعة النطاق للذكاء الاصطناعي في شكل تعزيز الأداء البشري بالكمبيوتر. وقد ثبت بالفعل أن التفاعل بين الطبيب والآلة يعمل على تعزيز عملية صنع القرار. استخدم علماء الأمراض الذكاء الاصطناعي لتقليل معدل الخطأ في التعرف على العقد الليمفاوية الإيجابية للسرطان من 3.4% إلى 0.5% (Sussillo and Barak, 2013). علاوة على ذلك، من خلال السماح بتحسين تحديد المرضى المعرضين للخطر، يمكن للذكاء الاصطناعي مساعدة الجراحين وأخصائيي الأشعة في تقليل معدل استئصال الورم بنسبة 30% لدى المرضى الذين تعتبر خزعات إبرة الثدي الخاصة بهم آفات عالية الخطورة ولكن تبين في النهاية أنها حميدة بعد الاستئصال الجراحي (Bahl et al., 2018).

في المستقبل، من المرجح أن يرى الجراح تحليل الذكاء الاصطناعي للسكان والبيانات الخاصة بالمريض مما يزيد من كل مرحلة من مراحل الرعاية. قبل الجراحة، قد يتتبع المريض الذي يخضع لتقييم جراحة السمنة الوزن والجلوكوز والوجبات والنشاط من خلال تطبيقات الهاتف المحمول وأجهزة تتبع اللياقة البدنية، مع تغذية البيانات في السجلات الطبية الإلكترونية الخاصة به (Harvey et al., 2016; Horner et al., 2017). يمكن للتحليل الآلي لجميع البيانات المتنقلة والسريية قبل الجراحة أن يوفر درجة مخاطر أكثر خاصة بالمريض للتخطيط الجراحي وينتج تنبؤات قيمة للرعاية بعد العملية الجراحية. يمكن للجراح بعد ذلك تعزيز عملية اتخاذ القرار أثناء العملية بناءً على التحليل في الوقت الفعلي للتقدم أثناء العملية الذي يدمج بيانات السجلات الطبية الإلكترونية مع الفيديو الجراحي، والعلامات الحيوية، وتتبع الأدوات/اليد، واستخدام الطاقة الجراحية الكهربائية. يمكن أن تؤدي المراقبة أثناء العملية لمثل هذه الأنواع المختلفة من البيانات إلى التنبؤ في الوقت الفعلي وتجنب الأحداث السلبية. يمكن أن يساعد دمج بيانات ما قبل العملية الجراحية وأثناءها وبعدها في مراقبة التعافي والتنبؤ بالمضاعفات. بعد الخروج من المستشفى، يمكن الاستمرار في دمج بيانات ما بعد الجراحة من الأجهزة الشخصية مع البيانات من المستشفى لتحقيق أقصى قدر من فقدان الوزن وحل الأمراض المصاحبة المرتبطة بالسمنة (Elvin-Walsh et al., 2018).

تأثير الذكاء الاصطناعي على تقليل تكاليف العمليات الجراحية

بعد سنوات عديدة من احتكار نظام دافنشي المذهل، تواجه شركة "Intuitive Surgical" أخيراً بعض المنافسة في السوق من الشركات العالمية التي تتنافس على احتلال مساحة الروبوتات الجراحية بإصداراتها الخاصة من روبوتات الجيل القادم (Rassweiler et al., 2017). ستكون وحدات التحكم المفتوحة والأدوات الأخف وزناً وإمكانية النقل الأكبر من الموضوعات المتكررة في هذه الأنظمة. بل إن هناك اهتماماً متجدداً بالأتمتة يعود إلى ما يقرب من 30 عاماً، أي إلى أيام جون ويكهام. يستطيع روبوت STAR خياطة الأمعاء بشكل أفضل من اليد البشرية ولكن دون تدخل بشري. استناداً إلى مفهوم الخياطة المستقلة الخاضعة للإشراف، فقد تم دمج التصوير ثلاثي الأبعاد وأجهزة الاستشعار (علامات الفلورسنت القريبة من الأشعة تحت الحمراء/علامات NIRF) للمشاركة في مفاغرة الأمعاء للخزير (Shademan et al., 2016). أكمل الروبوت الكوري Revo-i أول اختبار سريري على 17 مريضاً يخضعون لاستئصال البروستاتا الجذري بمساعدة الروبوتية (RARP). إنه مثال جيد على التقارير الصادقة، حيث حتى في أيدي ذوي الخبرة، خضع ثلاثة مرضى لنقل الدم وكان معدل الهامش الإيجابي 23% (Chang et al., 2018).

تتمتع الأجهزة الجديدة بالقدرة على تقليل تكلفة الجراحة الروبوتية لتكون مماثلة لتكلفة تنظير البطن على الرغم من أن النفقات الأولية للأجهزة قد تظل كبيرة. لدى شركة "Cambridge Medical Robotics" من المملكة المتحدة خطط لتقديم نماذج تكلفة أحدث تتجاوز مجرد صيانة الأجهزة والأدوات والأدوات المساعدة كحزمة شاملة. وهذا قد يجعل الروبوتات جذابة للتوسع متعدد التخصصات في الشرق، بين الجراحين ذوي العدد الكبير من الجراحين المفتوحين والمناظير. على سبيل المثال، في شرق الهند، حيث يكون سرطان البروستاتا نادراً ولكنه عدواني إلى حد ما لدى أولئك الذين يصابون به، فإن انخفاض التكاليف يمكن أن يشجع على قبول أكبر للجراحة الروبوتية. تظهر البيانات الصادرة عن مؤسسة فاتيكوني أن هناك حالياً 60 نظام دافنشي في الهند، نصف الجراحين تقريباً هم من أطباء المسالك البولية، ويعتبر RARP هو الإجراء الأكثر شيوعاً. أظهرت مراجعة لسلسلة معاصرة من RARPs من كولكاتا في سرطان البروستاتا عالي الخطورة بشكل رئيسي بقاء على قيد الحياة بدون تكرار كيميائي حيوي بنسبة 75% في 5 سنوات و 90% من البول. وفي حين أن بناء فريق متماسك متعدد التخصصات من شأنه أن يقلل التكاليف، فمن المرجح أن يؤدي تطبيق نموذج ماركوف إلى تحديد فعالية الجراحة الروبوتية من حيث التكلفة على المدى المتوسط في العالم النامي (Aruni et al., 2018).

في حين أن التكلفة قد تهيمن على العناوين الرئيسية، فإن الجانبين الآخرين في عالم الروبوتات الجديدة اللذان يسببان الإثارة هما الذكاء الاصطناعي (AI) والاتصالات الرقمية الأسرع. لقد بدأ عصر الذكاء الاصطناعي الجراحي، على الرغم من أن المفهوم ليس

جديداً، ويعود إلى عبقرية آلان تورينج، الذي كان لمهاراته في فك التشفير تأثير كبير على نتيجة الحرب العالمية الثانية. رغم أن الأمر قد يبدو عصرياً، إلا أنه قد يكون القوة الدافعة للمستقبل، حيث يعمل على رقمنة الممارسة الجراحية (Aruni et al., 2018).

وقد صمم مؤخراً أول نموذج أولي للجراحة الرقمية، ويتميز بقدرات روبوتية رائدة وتكنولوجيا الأجهزة الطبية الأفضل في فئتها. تعد الروبوتات والتصوير والأجهزة المتقدمة وتحليلات البيانات والاتصال ركائزها الأساسية. يتطلع واتسون من IBM أيضًا إلى أن يصبح مساعدًا جراحياً ذكياً. إنه نذير لمعلومات طبية غير محدودة، وذلك باستخدام معالجة اللغة الطبيعية لتوضيح شكوك الجراح. ويتم استخدامه حالياً لتحليل السجلات الطبية الإلكترونية وتسلسل جينات الورم بهدف صياغة خطط علاجية أكثر تخصيصاً. قد يتم إضفاء مزيد من الديمقراطية على الجراحة من خلال اتصال G5 فائق السرعة بزمن وصول منخفض. يمكن لإنترنت المهارات أن تجعل الجراحة الروبوتية عن بعد والتدريس والإرشاد متاحة بسهولة، بغض النظر عن موقع الجراح الخبير (Kim et al., 2018).

الاستنتاجات

أوجدت الدراسة أن أهداف الذكاء الاصطناعي تتضمن التحليل والفهم والتنبؤ. هذه الأهداف تبرز أهمية استخدام التكنولوجيا لتحليل البيانات وتعزيز القرارات. كما أن التعلم الآلي والتعلم العميق ومعالجة اللغة الطبيعية هم الأساس لتحقيق أهداف الذكاء الاصطناعي. أوجدت الدراسات السابقة أن الذكاء الاصطناعي يستخدم في مجال الطب في تجميع المعلومات واتخاذ القرارات الجراحية. التحليل المتقدم للبيانات يمكن أن يساهم في تقديم معلومات دقيقة للجراحين. تشير النتائج إلى بعض التحديات والقيود التي تواجه استخدام الذكاء الاصطناعي في الجراحة، مثل ضرورة فهم الإحصائيات وتطوير نماذج أفضل. علاوة على ذلك استعرضت النتائج الفوائد المحتملة لتطبيق الذكاء الاصطناعي في مجال الجراحة، مثل تحسين عمليات صنع القرار وتقليل التكاليف.

يمكن للذكاء الاصطناعي مساعدة المراكز الطبية على تحسين جودة الرعاية من خلال تحليل البيانات السريرية وتقديم توجيهات دقيقة للأطباء. ذلك يساعد على تحسين نتائج العلاج وتجنب الأخطاء الطبية. بالإضافة إلى ذلك، يمكن تحليل البيانات للمساهمة في تحسين التكلفة من خلال تقديم استراتيجيات فعالة لإدارة الموارد. إضافة إلى ذلك باستخدام التحليل الآلي، يمكن تقديم تقديرات دقيقة للمخاطر المحتملة والتكاليف المتوقعة لعمليات جراحية معينة. هذا يمكن أن يساعد القطاعات الطبية في وضع خطة اقتصادية وتحقيق توازن بين الجودة والتكلفة. أضافت النتائج ان الذكاء الاصطناعي يخفف العبء على الأطباء من خلال تحليل البيانات وتقديم المعلومات القيمة، يمكن للذكاء الاصطناعي دعم الأطباء في عمليات اتخاذ القرار، مما يقلل من الضغط عليهم ويسمح لهم بتقديم الرعاية بشكل أكثر فعالية. كما أن الذكاء الاصطناعي يزيد من دقة التشخيص ويحسن مراحل الرعاية المختلفة.

وفي دراسة تأثير الذكاء الاصطناعي على تقليل تكاليف العمليات الجراحية، تشير النتائج إلى وجود منافسة متزايدة في سوق الروبوتات الجراحية بعد سنوات من احتكار نظام دافنشي. هذا التنافس يشجع على التطوير والابتكار في هذا المجال، مما يمكن أن يؤدي إلى تقديم خيارات أكثر تقدماً وفعالية من حيث التكلفة. إضافة إلى ذلك الروبوتات الجراحية الجديدة تأتي مع تحسينات تكنولوجية تهدف إلى تقليل تكلفة الجراحة وزيادة الكفاءة. وحدات التحكم المفتوحة والأدوات الأخف وزناً وإمكانية النقل الأكبر تمثل جزءاً من هذه التحسينات. تشير النتائج إلى قدرة الأجهزة الجديدة على تقليل تكلفة الجراحة الروبوتية لتكون مماثلة لتكلفة نظير البطن. على الرغم من التكاليف الأولية الكبيرة للأجهزة، إلا أن توجه نحو تقديم نماذج تكلفة شاملة يمكن أن يجعل الروبوتات جذابة للتوسع في الاستخدام.

التوصيات

1. تضمين أمثلة تطبيقية من الدراسات الفعلية أو التجارب السريرية لتوضيح الفوائد والتحديات سيكون مفيدًا للقارئ.
2. من المهم استثمار مزيد من الجهود في البحث والابتكار في مجال الذكاء الاصطناعي لتطوير تقنيات جديدة وحلول مبتكرة. هذا يمكن أن يساهم في تقديم حلول أقل تكلفة في مجال الجراحة والرعاية الصحية.
3. يجب توجيه جهود إلى تقديم برامج تدريب وتعليم مخصصة للأطباء والجراحين حول كيفية استخدام تقنيات الذكاء الاصطناعي بشكل فعال. هذا يمكن أن يساهم في تحسين فهمهم للتحليلات والتوجيهات التي يمكن أن يقدمها الذكاء الاصطناعي.
4. من الضروري إجراء تقييمات مستمرة للتأثير والفعالية التي يحققها الذكاء الاصطناعي في المجال الطبي. هذا يمكن أن يساعد في تحديد النجاحات والتحسينات المطلوبة وتكييف النهج بناءً على الخبرات والنتائج.
5. يجب تقديم الدعم المناسب من حيث البنية التحتية والموارد التكنولوجية لتمكين تطبيق تقنيات الذكاء الاصطناعي في المجال الطبي. هذا يتضمن تطوير البنية التكنولوجية والبرمجيات والبنية التحتية للتخزين ومعالجة البيانات.
6. يمكن أن يكون هناك تحدي في التكاليف الأولية لتطبيق تقنيات الذكاء الاصطناعي. لذا، يجب النظر في تقديم نماذج تكلفة شاملة تشمل فوائد طويلة الأمد لتحقيق جذب أكبر للاستثمار في هذا المجال.

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تحضير وتشخيص معقدات من ليكنيدات ثنائي ثايوكارباميت المشتقة من الاحماض الامينية وتقييم فعاليتها الحيوية

Preparation and Characterization the Complexes of Dithiocarbamide Derived from Amino Acids and Evaluation of Their Biological Activity

سهى حسن احمد الجبوري¹

حسن احمد محمد²



Abstract

This research includes the preparation and characterization of a number of dithiocarbamate complexes of amino acids (tyrosine, and tryptophan) with a number of transitional elements Ni (II) and non-transitional elements Zn (II), Hg (II). The dithiocarbamate complexes were prepared directly in one container due to the difficulty of obtaining the ligands in a solid form. The complexes with the following general formulas were prepared:

1. Complexes with the formula $[M(\text{Tyrodtc})_2]$, where M= Ni(II), Zn(II) ratio (metal: ligand) (2:1).

2. Complexes with the formula $[M(\text{Tryptodtc})_2]$ where M= Zn(II), Hg(II) ratio (metal: ligand) (2:1).

The structural formulas of the prepared complexes have been verified by some physical methods such as molar conductivity, magnetic sensitivity measurements, electronic spectra and infrared spectra. (1H, 13C) NMR. These measurements of the tetracoordinated complexes indicated that they take a square planar shape around the Ni(II) metal ion, and a tetrahedral shape around the Zn(II), Hg(II) metal ions.

Key Words Dthiocarbamide ; Triptophan ; Tyrocine ; Amino Acids.

ملخص

تتضمن تحضير وتشخيص عدد من معقدات ثنائي ثايوكارباميت للاحماض الامينية (التايروسين و التريبتوفان) مع عدد من العناصر الانتقالية Ni(II) والعناصر غير الانتقالية Zn(II) ، Hg(II) ، وقد حضرت معقدات ثنائي ثايوكارباميت مباشرة في وعاء واحد لصعوبة الحصول على الليكاند بصورة صلبة حيث تم تحضير المعقدات ذات الصيغ العامة التالية :

1. معقدات ذات الصيغة $[M(\text{Tyrodtc})_2]$ حيث M= Ni(II) ، Zn(II) نسبة (الفلز: ليكاند). (2:1)

2. معقدات ذات الصيغة $[M(\text{Tryptodtc})_2]$ حيث M= Zn(II) ، Hg(II) نسبة (الفلز: ليكاند). (2:1)

تم التحقق من الصيغ التركيبية للمعقدات المحضرة بالطرائق الفيزيائية المعروفة مثل التوصيلية الكهربائية المولارية وقياسات الحساسية المغناطيسية والاطياف الالكترونية وطيف الاشعة تحت الحمراء. واطياف الرنين النووي المغناطيسي للكربون والبروتون. وقد دلت هذه قياسات المعقدات رباعية التناسق على اتخاذ شكل مربع مستوي حول ايون الفلز $[M = \text{Ni(II)}]$ ، ورباعي السطوح حول ايونات الفلزات $[\text{Zn(II)}]$ ، $[\text{Hg(II)}]$. كما تم دراسة المعقدات بتقنية XRD و SEM لمعرفة طبيعة معلومات حول تضاريس السطح وتكوين العينة ومن خلالها يتم معرفة حجم مكونات العينة للتأكد من انها يمكن ان تكون جسيمات نانوية. اختبرت المعقدات المحضرة لتقييم فعاليتها الحيوية وتبين ان قسم من المعقدات اعطت فعالية عالية مثل معقدات الزئبق واخرى فعالية اقل مثل معقدات النيكل.

الكلمات المفتاحية ثنائي ثايوكارباميت ؛ تريبتوفان ؛ تايروسين ؛ احماض امينية

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المقدمة

تعد مركبات (DTC) Dithiocarbamate اهم الليكاندات المحتوية على كبريت (S) كذرات مانحة ولها دورا كبيرا في الكيمياء التناسقية , حيث انها تسلك سلوك ليكاند ثنائي السن مع عديد من فلزات ثنائية وثلاثية التأكسد [1], ويمكن أن تسلك سلوكاً أحادي السن في بعض الأحيان ويحدث غالباً عندما تكون هناك اعاقه فراغية حول ذره الفلز المركزية, كما يمكن أن ترتبط ليكاندات ثنائي ثايوكارباميت (DTC) بشكل متعدد السن.[2]

أن ليكاندات ثنائي ثايوكارباميت تتناسق مع بعض الفلزات الانتقالية كليكاندات مخلبية ثنائية السن من خلال ذرتي الكبريت في المجموعة (CS₂) وتكون التراكيب الريزونانسية حيث يكون هذا النوع من التركيب هو الأكثر إسهاماً⁽⁶⁾⁽⁷⁾⁽⁸⁾. لذا فان ذرات الكبريت في ثنائي الثايوكارباميت لها ألفة الكترونية واطئة وقابلية كبيرة على اعطاء الالكترونات مقارنة بذرات الكبريت الموجودة بالتراكيب الاخرى[3]. تعتبر أيونات ثنائي ثايوكارباميت (R₁R₂NCS₂) من القواعد المرنة (Soft base) وهي ضمن الليكاندات الكيليتية المهمة في الكيمياء التناسقية [4].

إن معقدات ثنائي ثايوكارباميت المشتقة من الاحماض الامينية والفلزات الثنائية لقيت اهتمام خاص بالدراسة وذلك للتطبيقات العديدة التي دخلتها هذه المعقدات في مجالات التطبيقات الحياتية [5] والصحية والزراعية مثل المبيدات الحشرية ومبيدات الأعشاب ومبيدات الفطريات [6], وكذلك التطبيقات الصناعية [7], كما استخدمت معقدات ثنائي ثايوكارباميت (DTC) الفلزية لاعداد الجسيمات النانوية والأسلاك النانوية لمعدقات مختلفة من الفلزات شبه الموصله بما في ذلك (CdS و ZnS و PbS) [8]. ظهرت العديد من الطرق حول تحضير معقدات (dithiocarbamate), اذ يعد تحضير معقدات ثايوكارباميت الأحماض الأمينية وسيلة جديدة للحصول على معقدات لها فائدة في مجالات عديدة من الطب والصناعة والزراعة في كيمياء الثايوكارباميت , كشف الاطلاع على الأدبيات أن المركبات الفلزية التي تحتوي على ثنائي كارباميت مشتق من الأحماض الأمينية تكون قليلة جدًا. كما تم دراسة معقدات الأحماض الأمينية ومشتقات الاحماض الامينية مع أيونات العناصر الفلزية من خلال تأصرها مع مجموعة الكاربونيل ومجموعتي (S, NH) الواهبة للإلكترونات مع أملاح العناصر الفلزية في عام 1981 م حضر معقد النحاس الثنائي مع بعض الأحماض الأمينية الأروماتية والأليفاتية والحلقية الغير متجانسة وتم دراسة هذه المعقدات وقد شخضت بوساطة القياسات المغناطيسية وطرق طيفية مختلفة مثل الاطياف الالكترونية والأشعة تحت الحمراء والأشعة السينية [9].

الجزء العملي

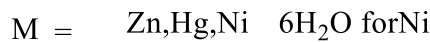
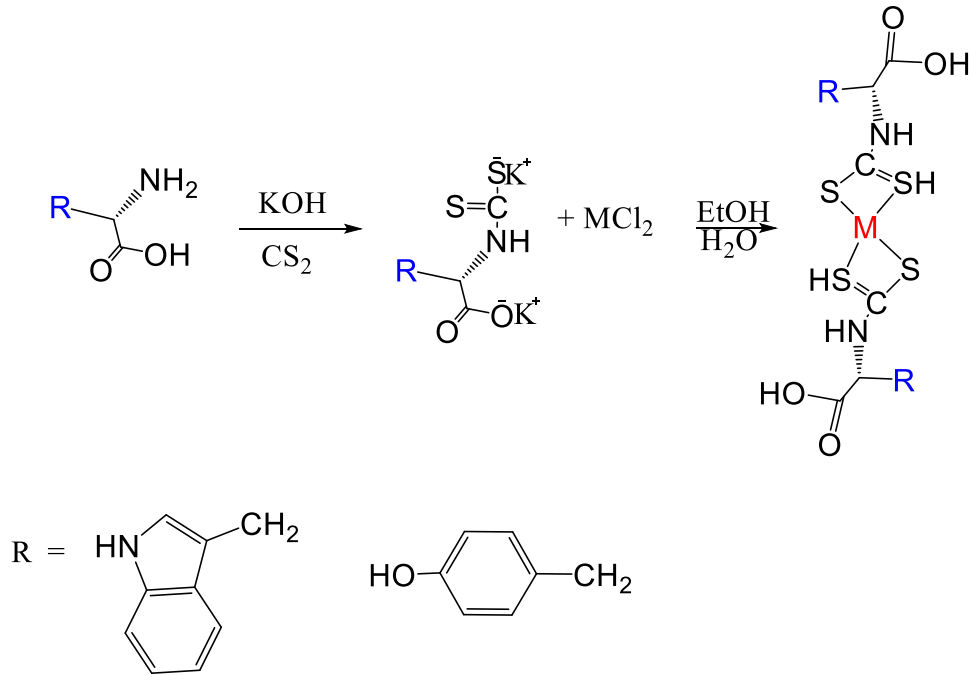
المواد الكيميائية: استخدمت المواد الكيميائية الاولية والمذيبات من الشركات المجهزة لها (BDH) (Scharlau) (Thomas Baker)(Aldrich) بدون اية عمليات تنقية اضافية

الشركة المجهزة	المواد الكيميائية	
BDH	تاريوسين	1
Thomas Baker	تريبتوفان	2
Scharlau	هيدروكسيد الصوديوم	3
BDH	ثنائي كلوريد النيكل سداسي الماء	4
Thomas Baker	كلوريد الزنك	5
BDH	كلوريد الزئبق	6
Aldrich	ثنائي كبريت الكاربون	7
BDH	الميثانول	8
BDH	ثنائي مثيل سلفوكسايد	9

الأجهزة المستخدمة (Instrumentation): قيست اطياف الاشعة تحت الحمراء باستخدام جهاز FT-IR نوع Bruker Alpha II في المنطقة المحصورة بين (400 - 4000) , كما قيست اطياف الاشعة فوق البنفسجية بجهاز UV – visbile Tg q2+ وبمدى (900 - 1100) وقيست اطياف NMR باستخدام جهاز Bruker 400 MHz وقيست قياس التوصيلية المولارية بجهاز OHAUS Starter.

تحضير الليكندات (dtyr) (dtyr): لم يتم الحصول على رواسب جافة عند تحضير ليكندات ثنائي ثايوكاريميت المشتقة من الاحماض الامينية الاخرى (الترتوفان والتايروسين) وان ما بشكل عجينة او رواسب زيتية لذا تم اللجوء الى تحضير المعقدات من المواد الاولية مباشرة.

تحضير المعقدات بنسبة 2:1 ليكنتين وفلز [M : L₂] : تم اذابة (0.0046 mole) من هيدروكسيد البوتاسيوم (KOH) و 0.0023 (mole) من الحامض الاميني ترتوفان او التايروسين بالايثانول وتم تسخين المزيج مع التحريك لإذابة المزيج لحين ظهور اللون الشفاف المائي لهذا المزيج بعدها تم تبريد المزيج في حمام ثلجي في درجة حرار (4C⁰) لمدة نصف ساعة تم اضافة (0.16g , 0.0023mol CS₂) تدريجياً لوحظ تحويل اللون الشفاف المائي الى اللون الاصفر الباهت وضع المزيج في الحمام الثلجي مع التحريك لمدة ساعة واحدة لإتمام التفاعل ثم اضافة ملح الفلز (ZnCl₂) (HgCl₂) اللامائي (NiCl₂.6H₂O) المائي المذاب في الايثانول تدريجياً الى المزيج لحين تغيير اللون الى الابيض الحليبي ويتم تصعيد المزيج لمدة ساعة ونصف لحين تغيير اللون الابيض الحليبي الى اللون الاصفر, ثم رشح المزيج وغسل الراسب الاصفر بالداي اثل اثير ثم جفف بالفرن الكهربائي وتم حساب النسبة المئوية للراسب (90%).



النتائج والمناقشة

القياسات الفيزيائية والطيفية

استناداً إلى النتائج المتضمنة من خلال الخواص الفيزيائية , وبالاعتماد على نتائج التحليل والنسبة المئوية المولية للتفاعل 2:1 (فلز: ليكند) . قيست التوصيلية الكهربائية المولارية للمعقدات المحضرة عند تركيز (10⁻³ مولاري) وباستخدام ثنائي مثيل

سلفوكسايد في درجة حرارة المختبر , وقد تبين ان التوصيلية المولارية تتفق مع الصيغ التركيبية المتوقعة للمعقدات المحضرة , حيث ظهرت ضمن مدى صنف المعقدات ذات السلوك المتعادل غير الالكتروليتي اي انها ضعيفة التوصيلية الكهربائية [10], واوضحت نتائج المغناطيسية لمعقدات الفلز(II) المحضرة بنسبة 2:1 قيم العزم المغناطيسي لمعقدات النيكل (II) ذات شكل مربع مستوي دايا مغناطيسي [11]:

الجدول 1. بعض الخواص الفيزيائية للمعقدات المحضرة

sq.	Compounds	% Yield	Color	Wight of MCl ₂ . XH ₂ O	M.P °C	Molar λ cond./ mole -1, cm-1 hom	(B.M.) Meff
.1	[Ni(try-dtc) ₂]	80%	اخضر فاتح	0.319g	200	5.1	Dia
.2	[Zn(try-dtc) ₂]	86%	اصفر ذهبي	0.163g	*245	5.8	-----
.3	[Zn(try-dtc) ₂]	91%	ابيض	0.184g	*225	15	-----
.4	[Hg(try-dtc) ₂]	60%	اسود	0.321g	*250	11	-----

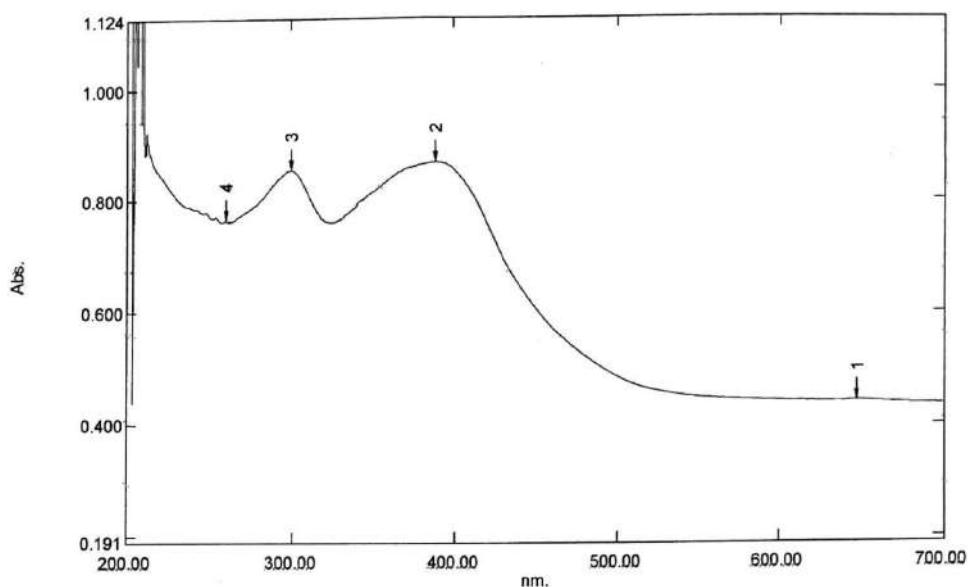
القياسات الطيفية

الاطياف الالكترونية:

تظهر في معقدات النيكل (II) ذو بنية المربع المستوي انقسام أوربيبتالات d الخمسة المنحلة تحت تأثير المجال البلوري، لذلك فان الطيف الالكتروني لهذه المعقدات يحوي على حزم امتصاص عند (15000 – 23000 cm⁻¹), (23000 – 27000 cm⁻¹)¹ وهذه الحزم غالبا ما تعود للانتقالات الالكترونية (¹A_{1g} → ¹A_{2g}) , (¹A_{1g} → ¹B_{1g}) [11] كما في الجدول (2) وهذا يؤكد بنية المربع المستوي لهذه المعقدات.

جدول 2. الاطياف الالكترونية (سم⁻¹) لمعقد النيكل الثنائي رباعية التناسق

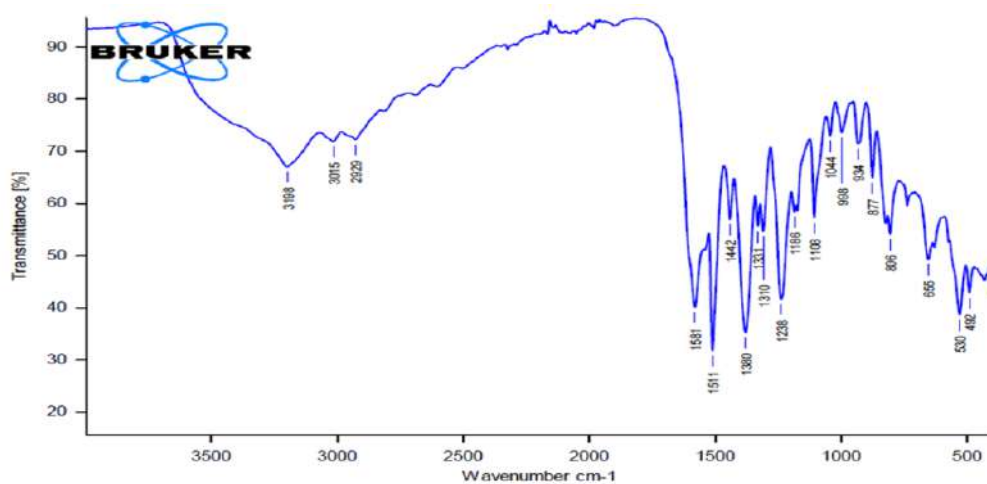
No.	¹ A _{1g} → ¹ A _{2g}		¹ A _{1g} → ¹ B _{1g}		C.T.bands	
	Nm	cm ⁻¹	Nm	cm ⁻¹	Nm	cm ⁻¹
[Ni(try-dtc) ₂]	647	15455.95	388	25773.2	260	38461.54



الشكل 1. لمعقد النيكل مربع مستوي [Ni(try-dtc)₂]

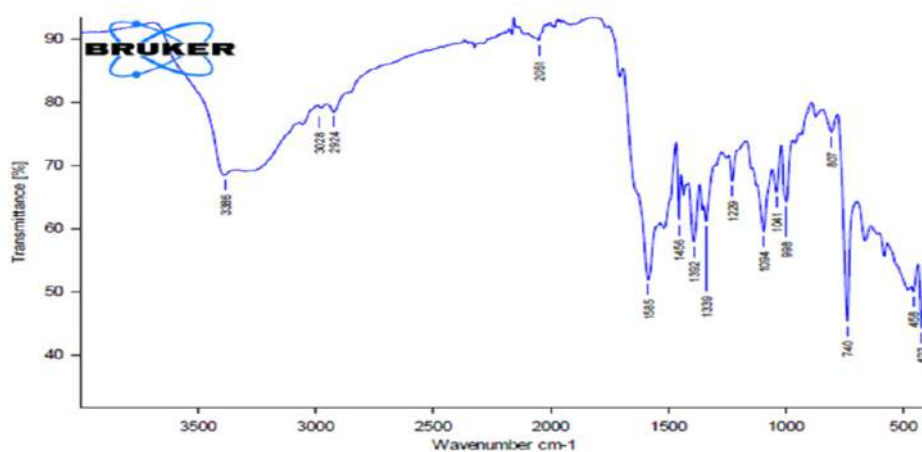
أطياف الاشعة تحت الحمراء

أظهرت أطياف الاشعة تحت الحمراء للمعقدات $[\text{Ni}(\text{tyr-dtc})_2]$ في الشكل (2) حزمة عند $(1153, 934\text{cm}^{-1})$ التي أعزيت الى $\text{U}(\text{C}=\text{S})$ و $\text{U}(\text{C}-\text{S})$ على التوالي اما حزم ليكاندات ثنائي ثايوكارباميت في هذه المعقدات فقد ظهرت حزمة قوية ومميزة ضمن المدى $(1442, 1380\text{cm}^{-1})$ أعزيت الى تردد مط مجموعة $\text{U}(\text{C}-\text{N})$, وحزمة قوية عند (1581cm^{-1}) تعود الى تردد مط مجموعة $\text{U}(\text{C}=\text{O})$ وكذلك أظهر الطيف حزمة متوسطة الى ضعيفة عند التردد (2929cm^{-1}) التي تعود الى تردد مط مجموعة $\text{U}(\text{C}-\text{H})$ الالفاتية, وأظهر الطيف حزمة متوسطة الى ضعيفة عند تردد (3015cm^{-1}) التي تعود الى تردد مط مجموعة $\text{U}(\text{C}-\text{H})$ الاروماتية وأظهر الطيف حزمة عريضة عند (3198cm^{-1}) التي أعزيت الى تردد مط مجموعة $\text{U}(\text{H}-\text{O})$ [12][13]



الشكل 2. يمثل طيف الاشعة تحت الحمراء للمعقد $[\text{Ni}(\text{tyr-dtc})_2]$

أظهرت أطياف الاشعة تحت الحمراء للمعقدات $[\text{Zn}(\text{try-dtc})_2]$ في الشكل (3) حزمة عند $(1094, 998\text{cm}^{-1})$ التي أعزيت الى $\text{U}(\text{C}=\text{S})$ و $\text{U}(\text{C}-\text{S})$ على التوالي اما حزم ليكاندات ثنائي ثايوكارباميت في هذه المعقدات فقد ظهرت حزمة قوية ومميزة عند $(1446, 1339\text{cm}^{-1})$ أعزيت الى تردد مط مجموعة $\text{U}(\text{C}-\text{N})$, وحزمة قوية عند (1585cm^{-1}) تعود الى تردد مط مجموعة $\text{U}(\text{C}=\text{O})$ وكذلك أظهر الطيف حزمة متوسطة الى ضعيفة عند التردد (2924cm^{-1}) التي تعود الى تردد مط مجموعة $\text{U}(\text{C}-\text{H})$ الالفاتية, وأظهر الطيف حزمة متوسطة الى ضعيفة عند تردد (3028cm^{-1}) التي تعود الى تردد مط مجموعة $\text{U}(\text{C}-\text{H})$ الاروماتية وأظهر الطيف حزمة عريضة عند (3386cm^{-1}) التي أعزيت الى تردد مط مجموعة $\text{U}(\text{H}-\text{O})$ [2][14]



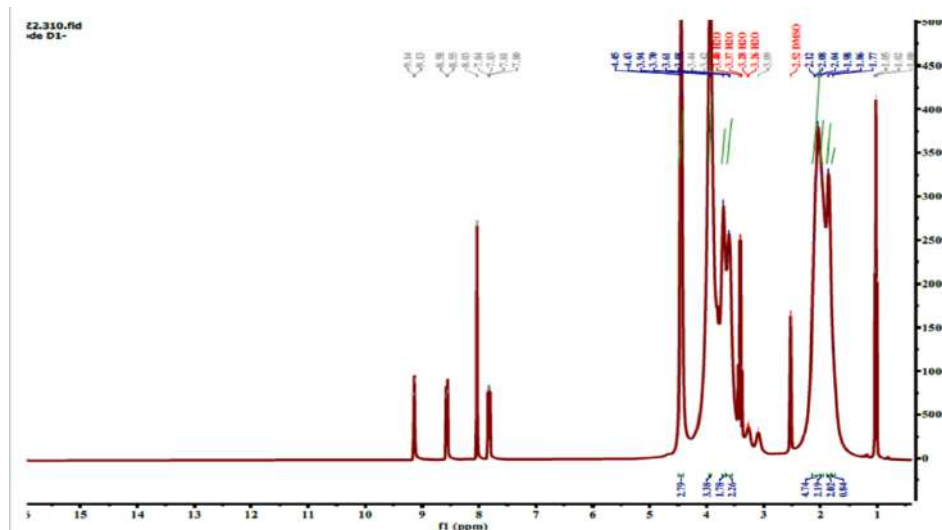
الشكل 3. يمثل طيف الاشعة تحت الحمراء للمعقد $[\text{Zn}(\text{try-dtc})_2]$

جدول 3. نتائج اطياف الاشعة تحت الاحمرء للمعقدات المحضرة

Sq.	Compounds	u(C-S)	u(C=S)	u(C-N)	u(C=O)	u(H-O)	u(C-H)	
							Ar.	Alph.
1	[Ni(try-dtc) ₂]	934m	1108m	1380s	1581s	3198m	3015m	2929w
2	[Zn(try-dtc) ₂]	988m	1094m	1446s	1585s	3386m	3028m	2924w
3	[Zn(try-dtc) ₂]	963 _m	1110m	1387s	1584s	3207m	3098w	2815w
4	[Hg(try-dtc) ₂]	994s	1037m	1339	1586s	3385m	3098w	2921w

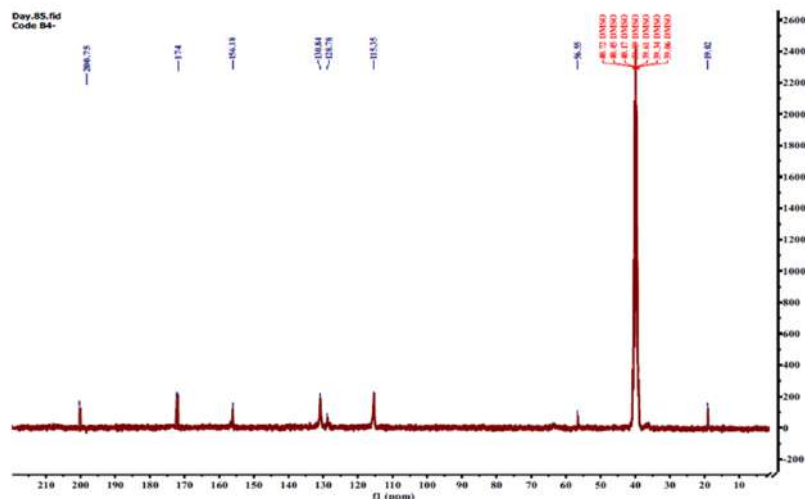
أطياف الرنين النووي المغناطيسي ¹H NMR

أظهر طيف ¹H NMR للمعقد الشكل (4) المقاس في مذيب ثنائي مثيل سلفوكسيد المعوض بالدتيروم اشارة خماسية لبروتونات مجموعة (2CH_{2-a}) للمعقد عند الازاحة الكيميائية (δH=1.05-1ppm) يبين تكاملها انها تقابل (4) بروتونات اما بروتونات مجموعة (2CH_{2-b}) اظهرت اشارة رباعية عند الازاحة الكيميائية (δH=1.98-1.77ppm) يبين تكاملها انها تقابل (4) بروتونات وظهرت اشارة ثلاثية عند الازاحة الكيميائية (δH=3.09ppm) والتي اعزيت الى بروتونات مجموعة (2CH_{2-c}) والتي يبين تكاملها انها تقابل (4) بروتونات كما اظهر طيف الرنين النووي المغناطيسي اشارة ثلاثية عند الازاحة الكيميائية (δH=3.94-3.42ppm) والتي اعزيت الى بروتونات مجموعة (2CH_{2-d}) والتي يبين تكاملها انها تقابل (2) بروتون كما اظهر اشارة احادية عند الازاحة الكيميائية (δH=4.45-4.43ppm) والتي اعزيت الى بروتون مجموعة (OH) والتي يبين تكاملها انها تقابل بروتونين. واظهر طيف الرنين النووي المغناطيسي اشارة متعدد عند الازاحة الكيميائية (δH=9.14-7.80 ppm) والتي اعزيت الى بروتونات الحلقات الاروماتية والتي يبين تكاملها انها تقابل (8) بروتونات [15][16][17].

الشكل 4. يوضح طيف الرنين النووي المغناطيسي ¹H N.M.R للمعقد [Hg(try-dtc)₂]أطياف الرنين النووي المغناطيسي للكربون ¹³C-NMR

أظهر طيف ¹³C-NMR للمعقد المقاس في مذيب DMSO-d₆ الموضحة في الشكل (5): ثمان إشارات تعود إلى المعقد ([Zn(Pro-dtc)₂]) حيث اظهرت الاطياف الازاحة الكيميائية لذرات الكربون في مجموعة المثيلين CH₂ وضمن (19.02) ppm δ

وازاحة كيميائية لمجموعة CH عند $\delta(130.84-56.55\text{ppm})$ وظهرت ازاحة كيميائية عند الموقع $\delta(174)$ ppm تعود لمجموعة الكربونيل اما مجموعة S=C-N فظهرت عند الموقع $\delta(200\text{ppm})$ ، كما موضح في الازاحات الكيميائية الاتية على التوالي ppm $\delta^{13}\text{C} = (200,174, 156.18, 130.84, 128.78, 115.35, 55.56, 19.02)$ [18][1].(C8,C7,C6,C5,C4,C3,C2,C1)

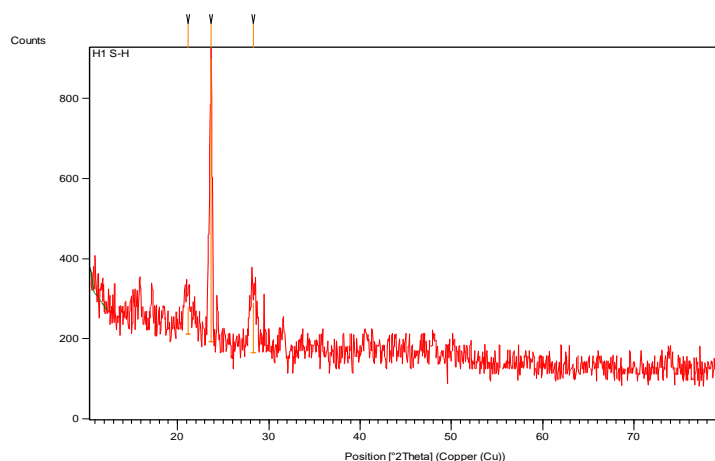


الشكل 5. يوضح طيف ^{13}C .NMR للمعقد $[\text{Zn}(\text{tyr-dtc})_2]$

أطياف الاشعة السينية XRD

تستخدم تقنية XRD في توصيف البنية البلورية للمواد المجهولة إذ تعطي بيانات دقيقة في حال كانت المواد بلورات أما إذا كانت المواد بشكل مسحوق فان البيانات المستحصلة تكون أقل دقة، إلا أنها تعطي فكرة جيدة على البنية البلورية للمواد تحت الاختبار [19][20].

أظهر المعقد $[\text{Zn}(\text{tyrdtc})_2]$ حيودا مختلفا عن تلك الانماط المسجلة للمعقدات الاخرى اذ اظهر فقط ثلاث قمم عند والتي تقابل المستويات البلورية 21.1347 و 23.6426 و 28.3094 والتي تقابل قيم FWHM 4.20031 و 3.76012 و 3.14998 على التوالي. من هذا يتضح ان هذا المعقد له تركيب بلوري يقترب ليكون غيربلوري (amorphous) مع معاملات ميلر تساوي 612 و 405 و 204 على التوالي وكما موضح في الشكل 9. تم حساب قيم الفواصل بين السطوح البلورية المرتبطة بالقمم وهي 1.28382- \AA 3.13687 باستخدام قانون براغ، الذي يربط زاوية الحيود بين السطوح البلورية في شبكة البلورة. تم حساب حجم الجسيمات باستعمال معادلة شيرر والتي كانت ضمن المدى 14.83-24.59 نانومتر وبمعدل حجم 18.90 نانومتر.



شكل 6. قياس XRD للمعقد $[\text{Zn}(\text{tyrdtc})_2]$

جدول 4. بيانات الاشعة السينية للمعقدات المحضرة وحجم الجسيمات المحسوب بمعادلة شيرر

Pos. [$^{\circ}2\theta$.]	Index	FWHM [$^{\circ}2\theta$.]	d-spacing [Å]	Particle size [nm]	Average particle size [nm]
[Zn(Tyrdtc) ₂]					
21.1347	612	2.3101	4.20031	3.66	12.82
23.6426	405	0.2989	3.76012	28.38	
28.3094	204	1.3348	3.14998	6.42	
40.5535	211	0.4443	2.22273	19.92	

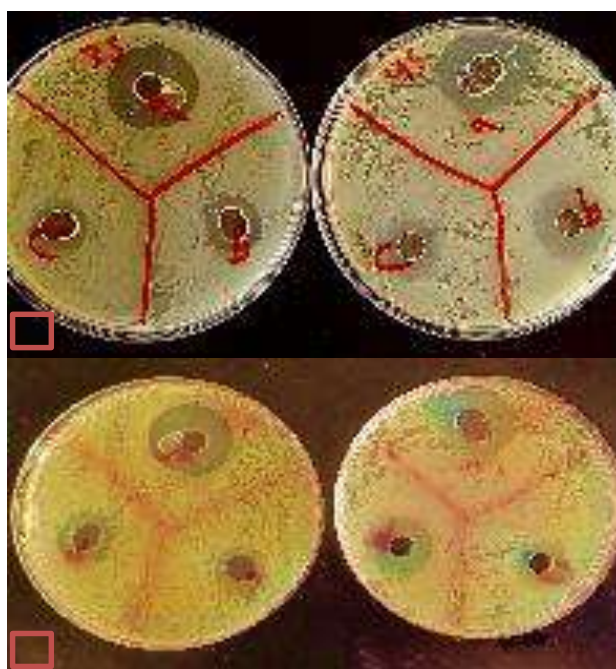
الفعالية البيولوجية Biological activity

بينت نتائج التحري عن الفعالية البيولوجية ان غالبية المركبات فعالية تجاه الاجناس البكتيرية المختارة قيد الدراسة وتم الاشارة الى الفعالية بقطر تثبيط البكتيريا حول حفر وسط الاكار المحملة بالمحاليل المحضرة في هذه الدراسة مقاسة بالمليمتر. جدول رقم (4) نتيجة اختبار الفعالية البيولوجية للمركبات المختارة تجاه الانواع البكتيرية مقاسة بالمليمتر حول حفرة الاكار المحملة بالمركبات الكيميائية [21][22][23].

جدول 5. نتائج فعالية المعقدات المحضرة لانواع من البكتريا

<i>E. coli</i>			<i>S.ureus</i>			الانواع البكتيرية رقم المحاليل
C	B	A	C	B	A	
n.a	n.a	n.a	n.a	n.a	n.a	[Zn(try-dtc) ₂]
n.a	n.a	n.a	0	0	10	[Zn(tyr-dtc) ₂]
20	20	27	0	11	18	[Hg(try-dtc) ₂]
0	12	12	n.a	n.a	n.a	[Ni(tyr-dtc) ₂]

(n.a)ت لم تظهر فعالية



الاستنتاجات

استناداً إلى النتائج السابقة ومن الدراسات الفيزيائية والطيفية ودراسة الفعالية الحيوية يمكن التوصل إلى أنّ الليكنيدات قد عملت بشكل ثنائي السن كليتي , حضرت معقدات ثنائي ثايوكاربميت المشتقة من الحامض الاميني من اضافة 1 مول من الحامض الاميني المذاب في الايثانول مضافا اليه 2 مول من هيدروكسيد البوتاسيوم المذاب في الايثانول ثم اضيف اليه مول واحد من ثنائي كبريتيد الكربون مع فلز وتكوين معقد رباعي التناسق حيث اتخذت شكل مربع مستوي بالنسبة لمعقد النيكل الثنائي ورباعي السطوح بالنسبة لمعقدي الزنك الثنائي والزنبيق الثنائي , ويكون المعقد مستقر بسبب الارتباط القوي بين ذرات الكبريت والفلز. وظهرت فعالية عالية ضد انواع البكتريا بكتيريا المكورات العنقودية *Staphylococcus aureus* و الاخرى سالبة لصبغة كرام بكتيريا اشيريشيا القولون , ويعزى ذلك بسبب احتواء المعقد على ذرات الكبريت. *E.coli*

Reference

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Computer Fluid Design Models of Thermal Performance of Heat Sink with Various Geometries of Notches

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Abstract

Various shapes of system are designed in reducing the loss of vital energy through wasteful use and improving the exchange of vital energy in the context of heat. This is done due to the increased demand for vitality worldwide. Increasing cooling capacity and maximizing heat sink efficacy are two of the most significant aims in developing contemporary thermal systems. In this current work, an attempt has been made to take into account the different geometries of the fins to improve the heat dissipation of the electronic heat sink numerically and experimentally. This study aims to study thermal performance of interrupted fins when compared to that of continuous fins, analyzing the thermal performance by using a range of rectangular fins arrays that covers different arrangements and different orientations, and, the construction of a mathematical equation correlating the temperature difference (i.e., the temperature of the base minus the temperature of the environment) to the duration of shutdowns. The former is the ratio of fins per time unit divided by the fin length. CFD study paved the way for deriving a base model using NASYS FLUENT for the numerical simulation of different heat sink geometries in particular. The validation process was carried out and showed good agreement with average differences of less than 9 % with the experimental temperature differences of three types of heat sinks. The results show that the temperature difference increases when the heat input increases, as the relationship between them is positive. A study shows that the highest temperature difference in the second model is due to the long interruption and the lowest temperature difference in the fifth model. The temperature reduction rate is 35%. The results also show that the percentage increase in the Nussle number of stag. 5-30 fins are 2.24% compared to the int.-5-30 fins and is higher compared to the cont. fin and corresponds to 17.9%. Furthermore, the findings reveal that the temperature differential between base and ambient rises with the increase of power consumption by 20, 40, 60, 80, 100, and 120 W for the different fin types. The highest temperature difference is seen in the Stag 5-30 rib. Another overlapping finding was the 22% improvement in the heat transfer coefficient of the third model compared to the first model.

Key Words *Heat ; Thermal Systems ; Nasys Fluent ; Notches*

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Introduction

Heat can be defined as the energy that transfers between two systems or between the system and its surroundings. It moves from one high-temperature surface to another at a lower temperature. Heat transport involves three mechanisms: conduction, convection, and radiation. To clarify, in the context of any specific system, there is always scope to investigate each mode of heat transfer individually, and in most cases, the results obtained can be used to determine the overall heat transfer rate in the system. Additionally, apart from the other cases, heat transmission in the system can take the form of heat combining multiple transfer processes as well as multiple processes that interact with one another, the conjugate issues [1].

The transfer of heat by convection is usually carried out through fins when a hot surface and a fluid flow over it are moving relative to each other and a temperature differential occurs between the surface and the fluid above it.. Convection heat transfer is divided into two types, forced and free or natural convection. In forced convection, the fluid moves under the act of external forces, such as a pump, blower, fan and suction device. In natural convection, the fluid motion occurs due to buoyancy force effect. The rate of heat transfer due to convection is affected by the characteristics of the flowing fluid. Therefore, heat transfer via convection has been classified consistent with the natural or the force of the fluid flow over the surface into a laminar or turbulent flow [2].

One of the key goals of contemporary thermal system design is to enhance cooling capacity while also optimizing heat sink efficiency. Therefore, envisioning the future of thermal engineering, by considering energy losses due to inefficiently used energy and creating heat in a more convenient form, sounds interesting to many thermal system specialists. Energy has become a global thing as it is demanded more from the world. A system with high thermal efficiency is only possible through the deployment of surfaces with high heat transfer coefficients and low volumetric heat exchangers [3].

1. Applications of Extended Surfaces Area (Fins)

There are many important applications for the fins, as follows:

- Automobile radiators
- Air-cooling cylinder heads in internal combustion engines (scooters, motorcycles, aviation engines) and air compressors.
- Steam power plant economizers.
- Various industries utilize heat exchangers.
- Cooling of electric motors and transformers.

- Cooling electronics, semiconductors, and circuit boards. Some common applications of the fins are observed in figure (1).



Figure 1. Applications of Extended surfaces (fins).

2. Present Study Objectives

The main objectives the can be described as in below:

- Thermal performance of interrupted fins: one of the main objects of the current study is to investigate the thermal performance of interrupted fins in comparison with that of the continuous fins. This is important as using interruption leads to the reduction of size, weight and cost.
- Effect of interruption arrangement: Another main object of the present study is to analyze the thermal performance using a range of rectangular fins arrays that covers different arrangements and different orientations. This also seeks to discover the ideal fin arrangement and spacing that result in a better heat transfer coefficient and a lower base temperature.
- Developed an empirical equation relating temperature differential (base temperature - ambient temperature) to interruption length. The latter can be defined as the ratio of the fin's horizontal gap to its length. In addition, a correlation was discovered between the Nusselt number, Raleigh number, and angle of inclination of the fins.

Literature review

1. Numerical Studies

Ben Nakhi, Abdullatif and Ali J. Chamkha (2007) heat transfer coefficient is a function of free convection, tip and overlap ratio as well as heat flow. Also, this similarity increases with increase in heat flux. As noted by Árularasan R. and Velraj R. (2008), best heat sink values are achieved in fin height, fin thickness, base height, and fin pitch as 48 mm, 1.6 mm, 8 mm and 4 mm, respectively. M Baris Dogruoz & G Mehmet Arik (2008) Aluminum is among the highly-desirable material because of its high heat conductivity ($K = 201$) and light weight ($\rho = 2700$) kg/m³. Although H.G. Baskaya and M. Sivrioglu (2008) does not find linear relationship between the coefficient of heat transfer and the clearance parameter, the heat transfer coefficient does improve with increasing height and spacing of fins.

A. S. Alosaimy (2011) When increasing spacing the heat transfer coefficient increase Mahdi Fahiminia, Mohammad Mahdi Naserian, Hamid Reza Goshayeshi, and Davood Majidian (2011) The convection rates increase with increasing fin spacing. Abdullah and M. AlEssa (2012) the heat transfer dissipation from heat sink with perforation greater than the solid heat sink, when perforation increase the heat transfer increase and the material for making the fins decrease. Mohsen Torabi, Abdul Aziz and Kaili Zhang (2012) the influence of thermal conductivity, emissivity, and the parameter that effect on heat transfer coefficient Karvinen, R., and T. Karvinen (2012) It is unnecessary to analyze the convection heat transfer coefficients since convection is already included in these variables when the flow type is defined. Rupali, Abhay S., Nilawar and Yogesh (2013) When the number of perforation increase the heat transfer increase. Ilker Tari and Mehdi Mehrtash in their work (2013) showed that the increase of the surface temperature is an outcome of the heat exchange between the air and the fin surfaces. R. Sam Sukumar, G. Sriharsha, S. Bala Arun and P. Dilip kumar, Ch. Sanyasi Naidu (2013) the perforated interrupted fins threads were performing better than the interrupted ones as the heat dissipation was higher, and since they have the perforations the fins would have less weight. A. N. Almaeeni, H. R. Summers, J. Thompson and N. Kapoor (2013) increased the maximum fins height up to 23.9 millimeter and cold lid height was also optimised as 30 millimeters. Due to this, T_{case} had a drop of 22 % degree in terms of temperature itself. Salila Ranjan Dixit, Dr Tarinicharana Panda (2013) Increase the power input the coefficient of heat transfer ascend additionally and Nusselt range ascend, as well as, when increase fin spacing at a constant heat flux, Rayleigh number increase. M. K. Pathak, et al. (2013) The effect of increasing L/H increases Nu at any Rayleigh number, and that Nu increases with increasing the number of fins (i.e., decreasing S/H).

Al-Hamadani, Ali AF, and Abbas Jassim Jubear (2015) As a consequence of the fin interruption technique, the boundary layer was re-set, which enabled thermal performance of the fins to be enhanced and fin weight to be reduced. HARAHA, Fadwa, Ahmed, and Mourad TAHA JANAN (2015) The Graphite is the most efficient heat dissipating than Aluminum and Copper. Prasad, Devanshu (2015) Increasing fin spacing improves convective heat transmission until it reaches optimal spacing and then begins to decrease. This is owing to the higher heat transfer coefficient but lower surface area. Abhishek Soi (2015) Heat sinks with vertical rectangular fins perform better when interruptions are added. Suha K. Jebir (2017) the fin convection heat transfer with a horizontal position is less compared with inclined and vertical.

2. Experimental Studies

M.J. Sable¹, S.J. Jagtap, P.S. Patil, P.R. Baviskar⁴ and S.B. Barve (2010) Found that V-type partition plates better than vertical rectangular fin array in heat transfer performance. Shivdas S. Kharche & Hemant S. Farkade (2012) Heat is transported more efficiently in fins with a notch than in those without. They also observed that copper has a greater heat transfer rate. Fahiminia, Mahdi, and others (2012) Removal of the material from the heat sink's core increases its thermal and hydraulic performance. According to Vinod M. Wankar and S.G. Taji (2012), increasing the heat transfer coefficient leads to an increase in ΔT . Heat transfer coefficients rise as spacing increases. Average heat transmission increased in the optimal spacing (9 - 11) mm in natural convection mode. S.G. Taji, G.V. Parishwad, and N.K. Sane (2014) found that the ideal spacings for natural and mixed convection ($Re = 1$) are 10 and 4-6 mm, respectively. Abbas Jassem Jubear, (2017) Adding interrupted fins to a heat sink improved thermal performance by around 15%. The optimal fin length for heat transmission was $l = 10$ mm.

3. Numerical and Experimental Studies

S. Mahmouda, R. Al-Dadah a, D.K. Aspinwall, S.L. Soo, and H. Hemida (2011) The convective heat transfer coefficient values rose with fin spacing but dropped with fin height. According to Chen et al. (2013), The inverse approach and numerical analysis work well together.

Ahmadi, Mehran, Golnoosh Mostafavi, & Majid Bahrami (2014) The insertion of interruptions to vertical rectangular fins improves their thermal efficiency, and the appropriate length of the interruptions has been found. Rameshwar B. Hagote, Sachin K. Dahake (2014) When compared to horizontal and inclined plate orientations, as well as vertical plates, the heat sink with V-fin array inclined base plate (600°) has a greater average heat transfer coefficient with the same surface area. Rane, Bhushan S., and M. D. Shende (2014) Adding staggered interruptions to vertically rectangular fins will significantly increase thermal performance over inline interrupted fins. Khudheyer, Ahmed F.,

and Zaid Hameed Hasan (2015) the coefficient of heat transfer decreases when the fins are extended for continuous at the same heat flux, with a fin height of 18 mm, and a space of 5 mm between fins, and at 500 mm in length the heat transfer coefficient reaches its lowest value. Pande, Kaustubh, and Omkar Siras (2016) the splitting of the fins resulted in ~40% increase in the heat transfer rate.

Observing past studies reveals that many publications focus on numerical analysis using diverse methodologies. This might be explained by the fact that numerical modeling is easier to perform than experimental work. Furthermore, it is often less costly and may be used frequently to gather large amounts of data by just tweaking a few settings. Such researchers built mathematical models or empirical correlations, defining heat transfer coefficients by the temperature delta (difference between the base plate temperature and the ambient temperature). Other empirical equations come in to illustrate the interconnections between the Nusselt number and the Raleigh number.

However, to the best of the author's knowledge, the literature has not focused on the examination of interrupted fins. There are, for example, various fin configurations and orientations that require additional exploration. As mentioned before, power electronics is shrinking in sizes which lead to more thermal losses. Consequently, any dangerous additional heat will originate from the heat sinks, and their constant expulsion of heat should be taken into account. It is essential to research into cooling solutions because the effectiveness of the cooling mechanisms greatly affects not only performance but also reliability of electrical and power electronics devices.

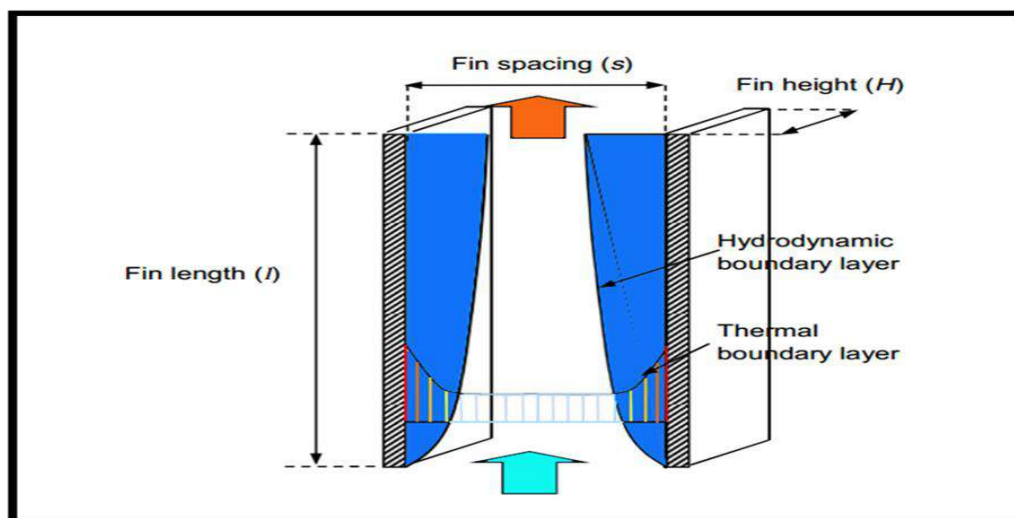


Figure 2. A schematic of the thermal and hydrodynamic boundary layers on a vertical fin array with its geometric parameters.

The Substantial Axes of the Current Study

Based on the discussion presented in the previous section, the current study will be divided into two main parts as follow:

1. Fin arrays are vertical and rectangular.

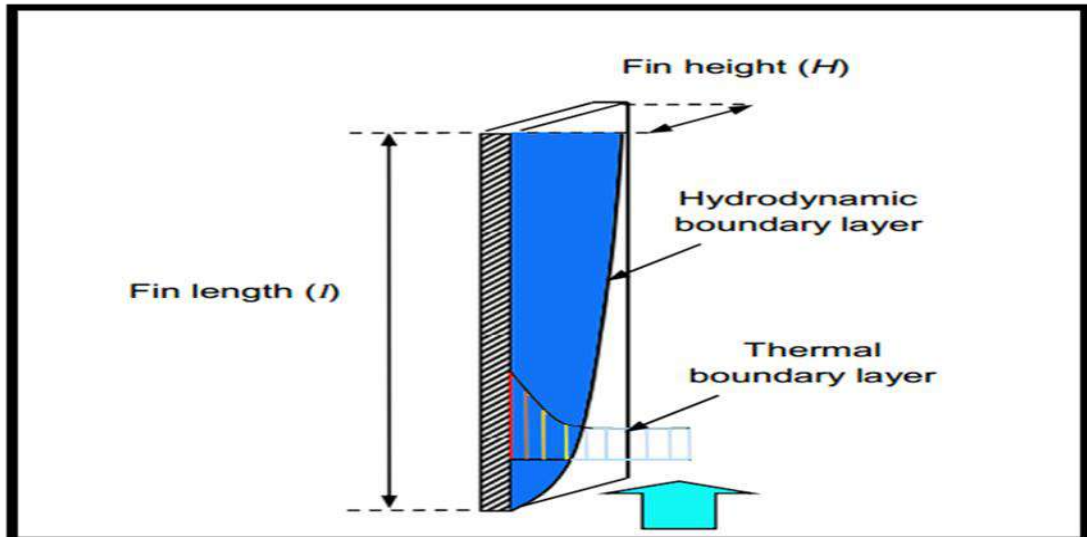


Figure 3. portrays a diagram of a vertical rectangular heat sink array, its geometric factors, and the hydrodynamic and thermal boundary layers.

2. Vertical pin fins

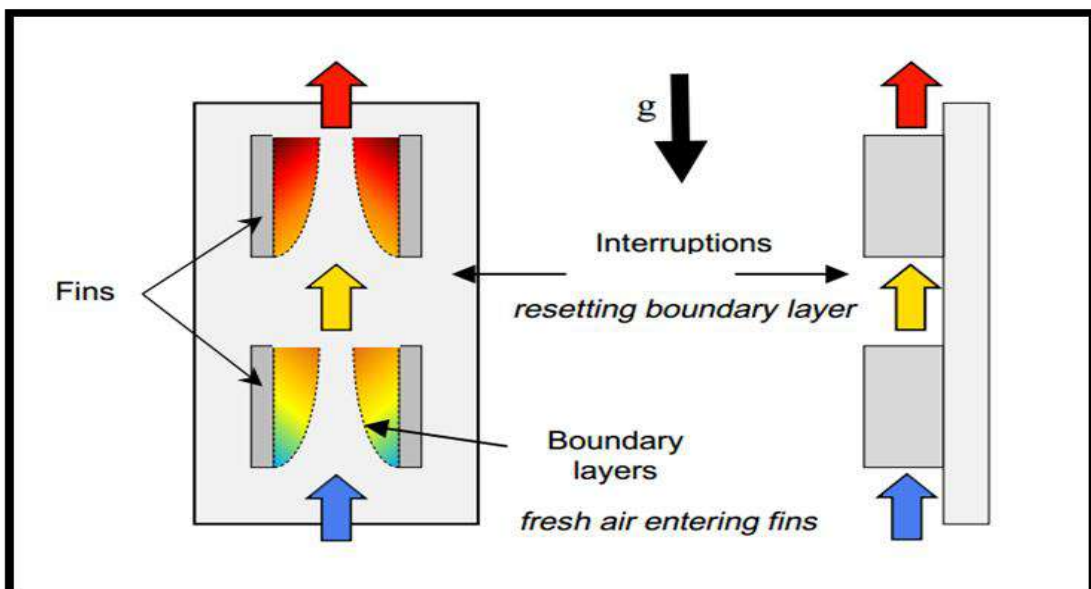


Figure 4. shows the geometrical parameters of vertical pin fins which have been deemed.

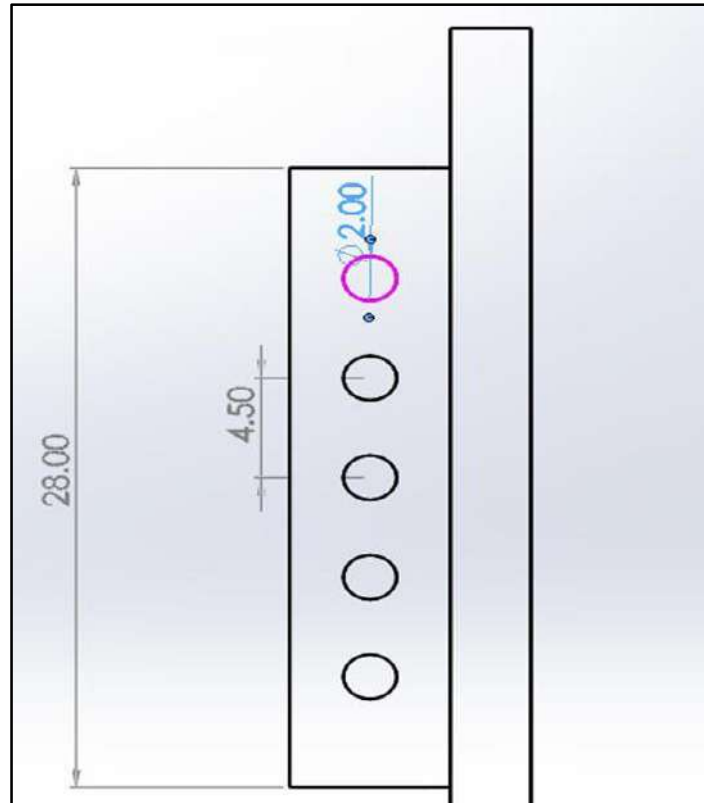


Figure 5. A vertical pin fin's geometric parameters and boundary layers.

This research is designed to study the role of irregular segments and the wall in the determination of the target course. The intent switch of the thermal boundary layer will produce a displacement which contributes to a thermally growing flow regime generating a lot of heat transfer resistance which can lead to a higher natural heat transfer coefficient. figure (6) in a more spatial way.

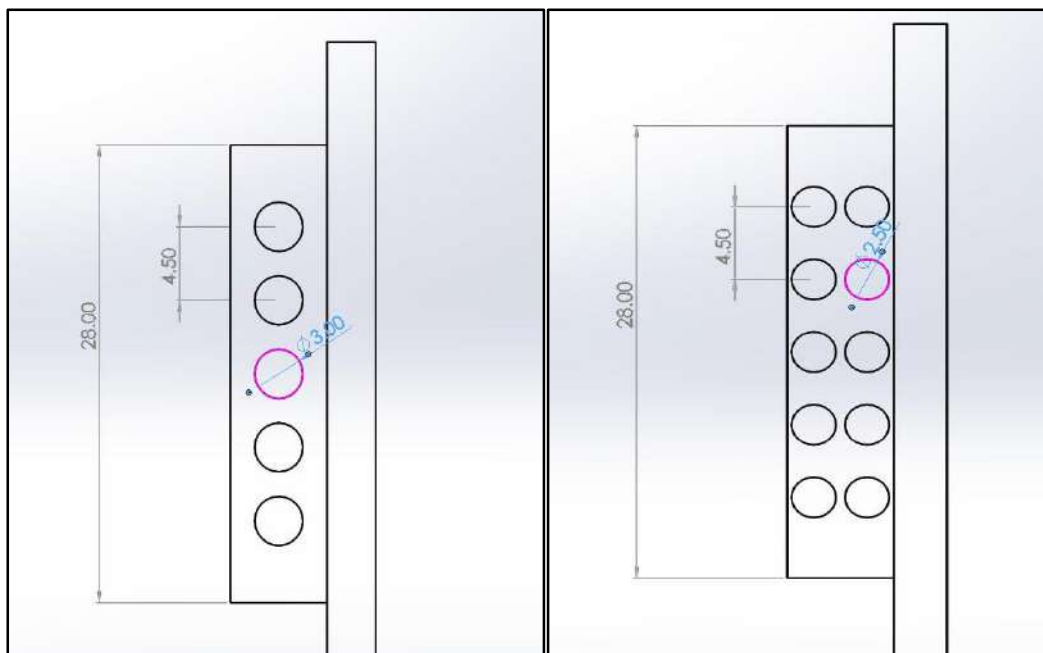


Figure 6. Effect of adding interruptions.

Result

1. fin height Effect

Figure (7) shows the heat transfer coefficient vs. heat input as the fin height varies from 12 to 24 mm. The fin length was 305 mm, with a fin spacing of 9.5 mm. As expected, the fin coefficient of heat transmission is determined by the fin's height and average temperature. Conclusion: As fin height and heat input increased, the fin's heat transfer coefficient improved. As indicated in the figure, with a fin height of 12 mm, the heat transfer coefficient is minimal in comparison to the fin height of 17.5 mm. When the fin height exceeds 24 mm, the heat transfer coefficient improves only little, particularly at high heat input values. The fundamental reason for this behavior is that increasing the fin height increases the surface area, which improves convection heat transmission. However, increasing fin height leads to weight growth, hence the ideal height for this investigation is $H=17.5$ mm.

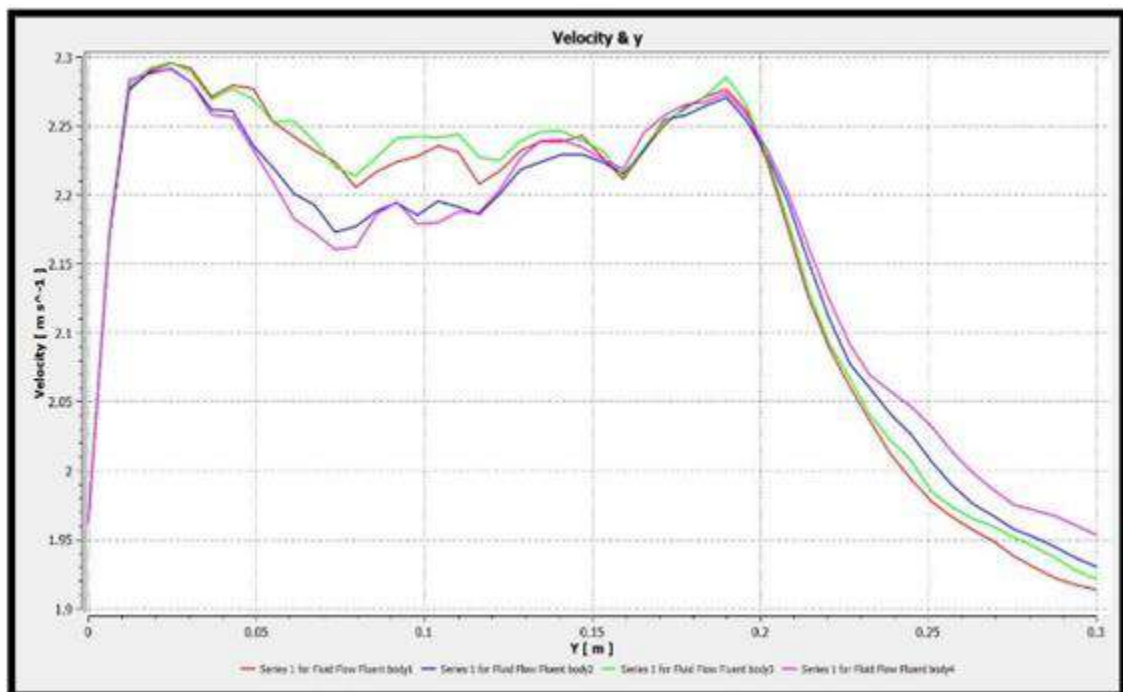


Figure 7. Variation of heat transfer coefficient with heat input at various fin heights for continuous fins

2. Fin Length Effect

Figure (8) depicts the relationship between the coefficient of heat transfer and continuous fin heat input with different lengths (305, 405, and 505 mm). The fin's height and spacing are 17.5 and 9.5 mm, respectively. The results suggest that increasing the fin length reduces the heat transfer coefficient. This is because increasing the length of the fins lessens the velocity of air. As a result, the surrounding layer grows to its maximum potential, resulting in a performance loss. Additionally, the enlarged surface area has been reduced.

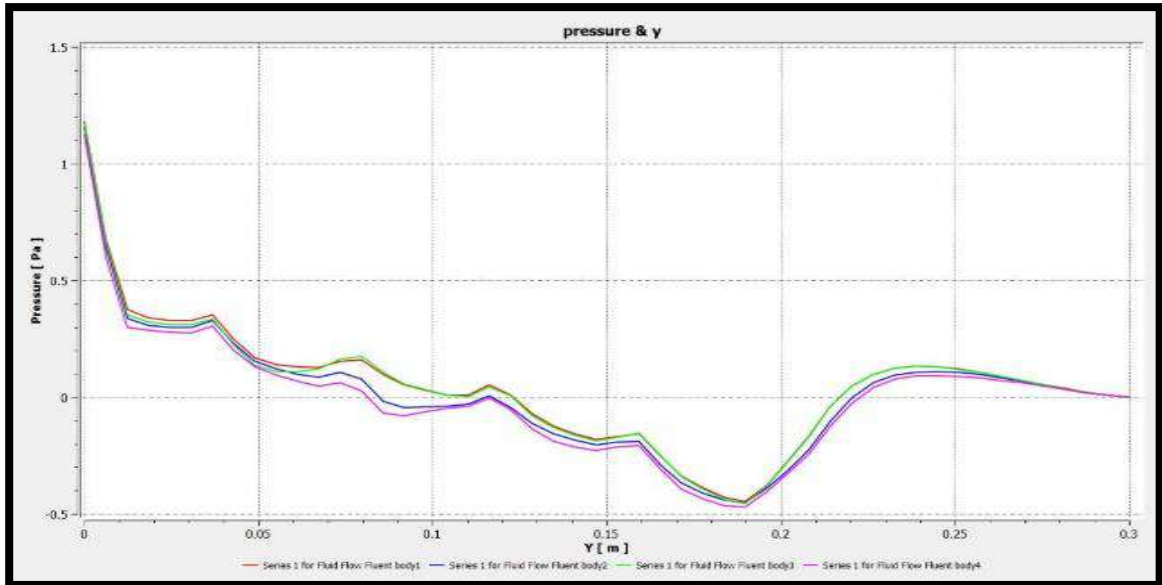


Figure 8. Variation in the heat transfer coefficient with varied fin lengths for continuous fins.

3. Impact of fin stoppage on heat transfer coefficient.

Graphs (Figure 9) and (Figure 10) illustrated filling curves for interruption length $L = 305$ mm, a fin spacing $S = 9.5$ mm and a fin height $H = 17.5$ mm. Figure (9) depicts a heat sink with an interruption formed from an array of fins with interruption lengths varying in stages of $G = 10$ mm, $G = 20$ mm, and $G = 30$ mm. This graph demonstrates how the heat transfer coefficient improves as G increases. The coefficient of heat transfer improves as the "better" disruption in the thermal boundary layer is generated by increasing the fin interruption length " G ".

Figure (10) depicts the coefficient of heat transmission as a function of the interruption number. The number of interruptions was increased from one to five, while the interruption duration remained at 30 mm. As seen in the image, increasing the number of interruptions improves the coefficient of convection heat transmission. This can be viewed as an increase in the interruption number causing the thermal boundary layer to re-grow at the beginning of each fin row.

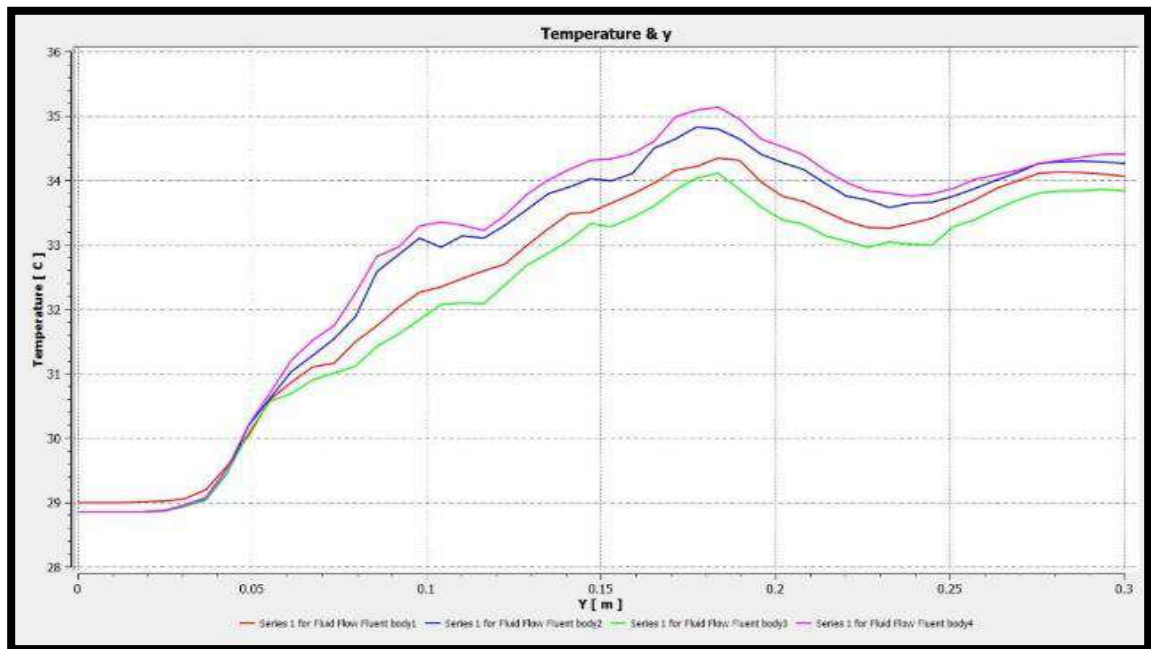


Figure 9. Heat transmission coefficient varies with heat input. Throughout varied interruption times (G)

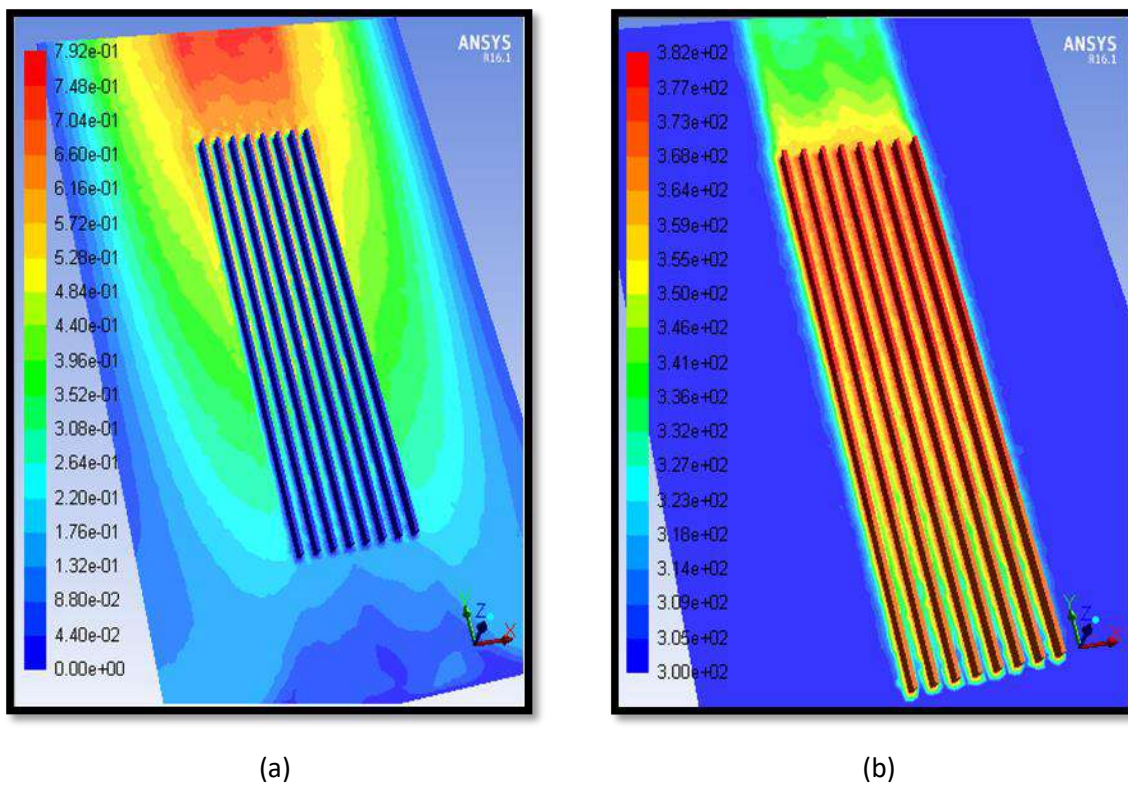


Figure 10. Cont. fins' velocity and temperature contours: a) Temperature division (k) and b) Velocity division (m/s)

4. Velocity and Temperature Contours

Figures (11) to (15) are drawn to illustrate the location of the highest degree of temperature for the vertical fin, as well as showing the velocity alteration over the fin. These sketches portray the distribution of base temperature and the contours of velocity for [continues fins, int-5-30, int-5-30-zigzag(45°), int-5-30-zigzag (60°), int-5-30-angle (60°), stag-5-30, stag-5-30-zigzag (60°), and stag-5-30-angle (60°)] fin respectively, at the value of heat input equal to 60 watts. To investigate the system's flow and thermal properties, velocity and temperature contours were constructed in a plane at the fin's mid-height. The heat contour shows that the lowest temperature is at the bottom edge and the highest at the top edge of the fins. In the velocity contour, the flow is symmetric in the first six examples, but in the last two, the maximum velocity is shown to the left of the fins owing to a change in the flow direction.

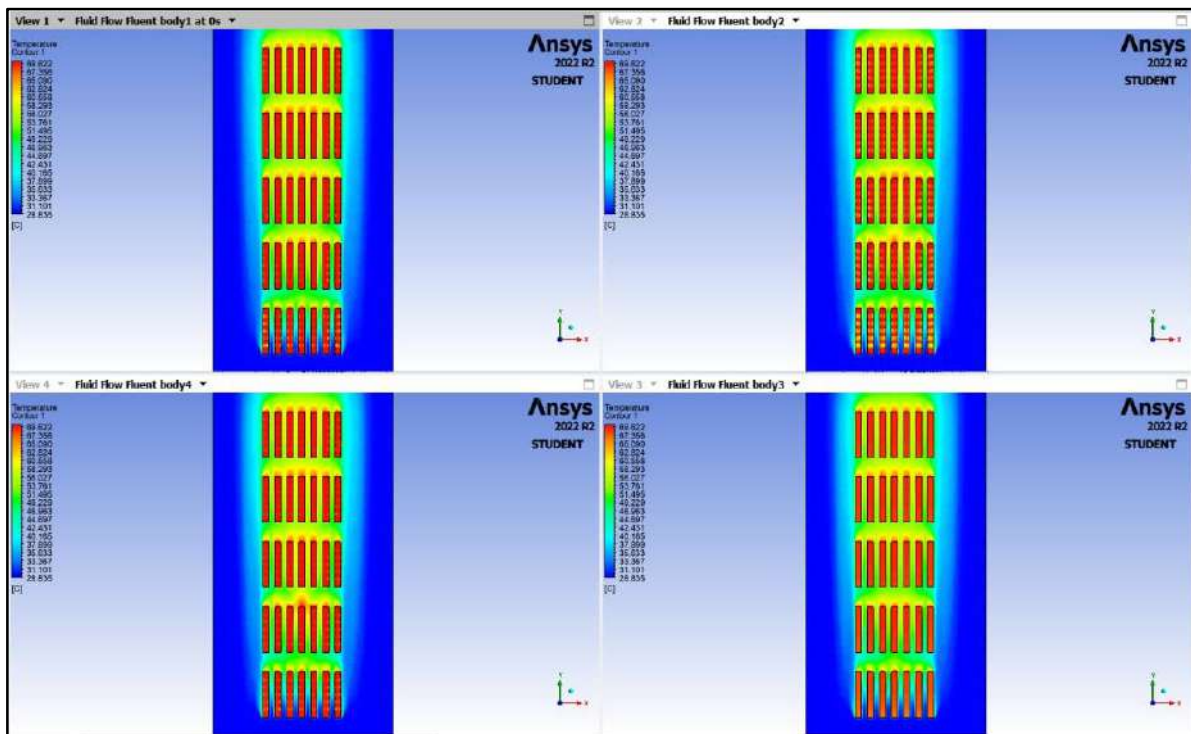


Figure 11. the continuous fin's velocity and temperature contours are as follows: a) Temperature division (k) and b) Velocity division (m/s).

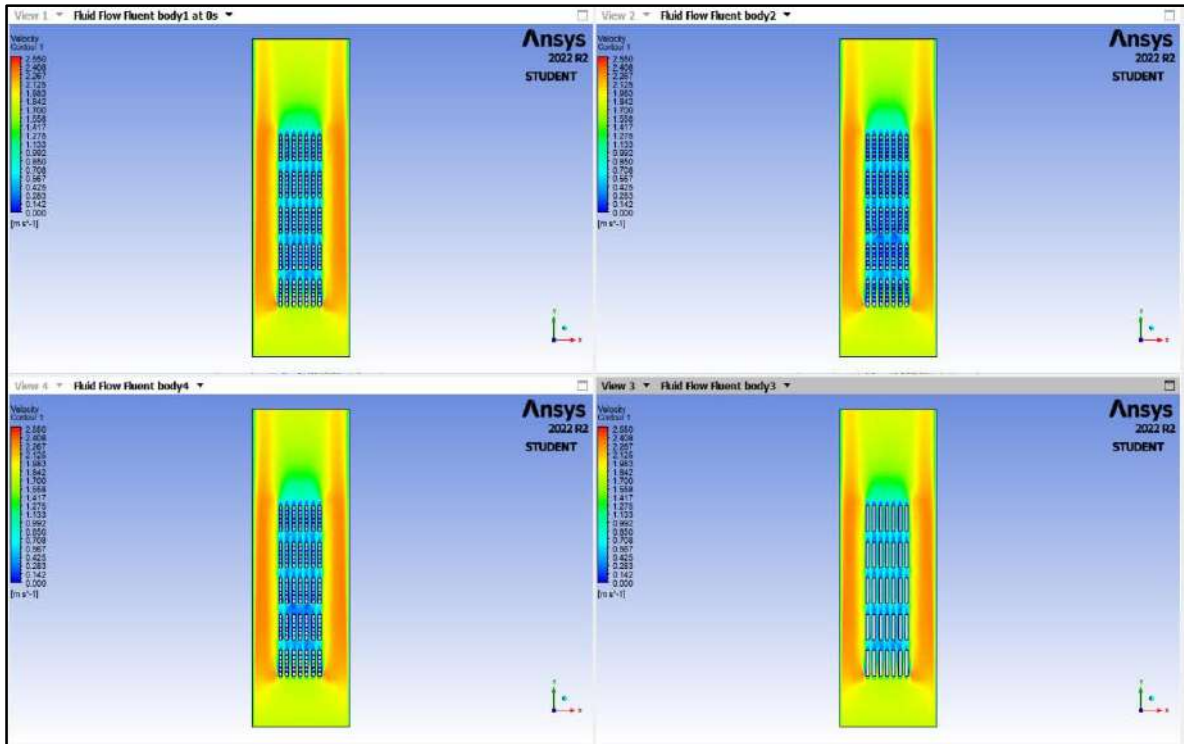


Figure 12. the continuous fin's velocity and temperature contours are shown as follows: a) Temperature division (k) and b) Velocity division (m/s)

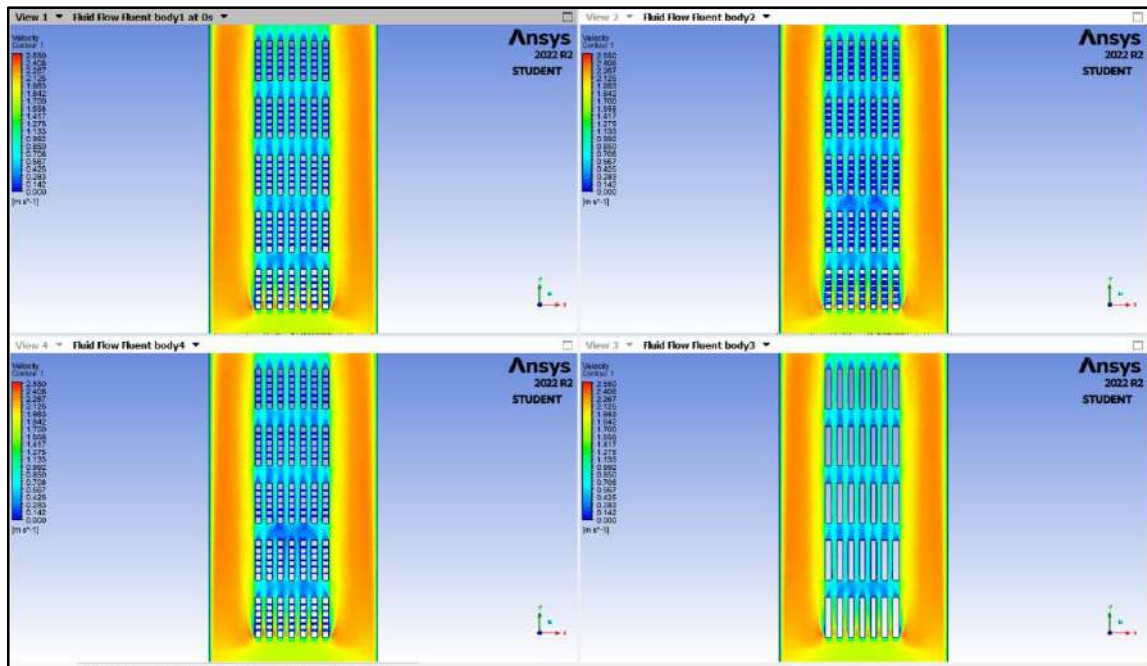


Figure 13 Velocity and temperature contours of the stag-5-30-zigzag (60°) fins: a) Temperature division (k) and b) Velocity division (m/s).

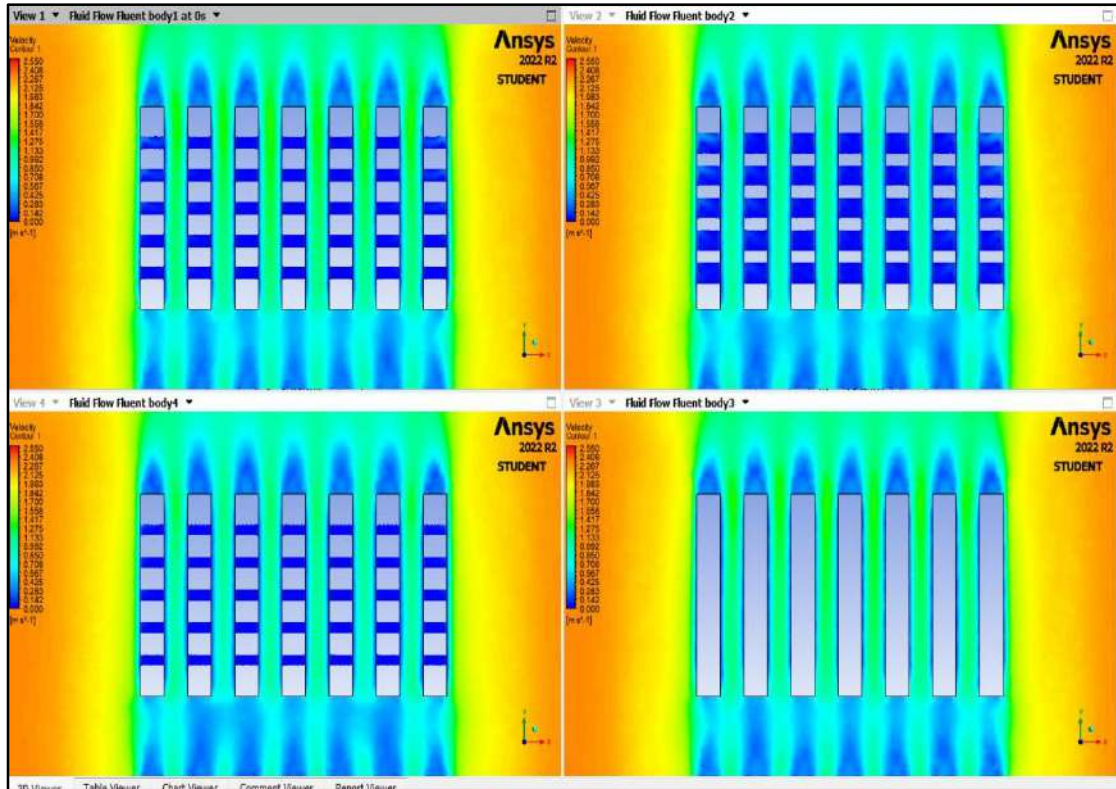


Figure 14. Velocity and temperature contours of the stag-5-30-zigzag (60°) fins: a) Temperature division (k) and b) Velocity division (m/s)

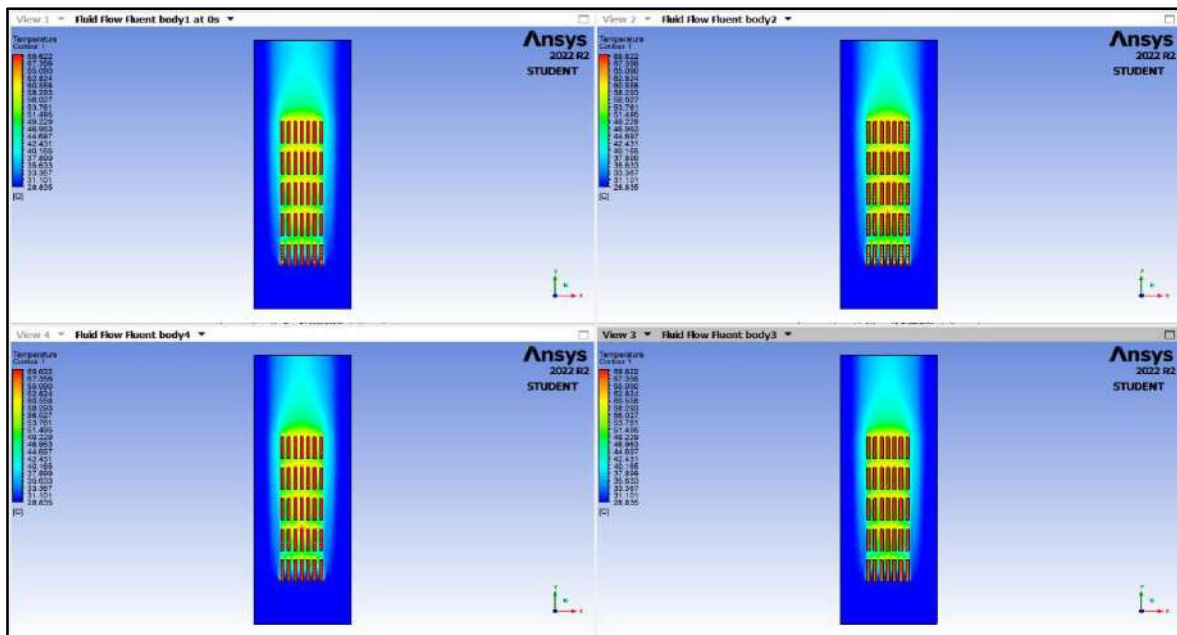


Figure 15. Velocity and Temperature contours of the int-5-30-zigzag (45°): a) Temperature Contours for P=60 W and b) Velocity Contours for P=60 W.

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